DRB Decision Number: CBDRB-FY20-362

Evaluating the Utility of Emergency Department Encounter Data and Examining Social Determinants of Emergency Department Utilization in Utah

David Powers, Sara Robinson, Edward Berchick, J. Alex Branham, Lucinda Dalzell, Lorelle Dennis, Kristi Eckerson, Alfred Gottschalck, Joanna Motro, John Posey, Andrew Verdon, and Victoria Udalova[1]

U.S. Census Bureau

SEHSD Working Paper 2021-07
June 2021

[1] This manuscript is intended to inform interested parties of ongoing research and to encourage discussion. Any views expressed are those of the authors and not those of the U.S. Census Bureau. The U.S. Census Bureau reviewed this data product for unauthorized disclosure of confidential information and approved the disclosure avoidance practices applied to this release (from CBDRB-FY20-362). We acknowledge Eloise Parker's support who championed this project from its early days. We received tremendous support from our partners, Utah Department of Health (UDOH) and the National Center for Health Statistics (NCHS). In particular, we thank Wu Xu (retired), Navina Forsythe, and Sterling Petersen from UDOH and Carol DeFrances and Brian Ward from NCHS who have supported this project from the very beginning. We also thank our numerous reviewers for their helpful comments.

Author contributions: Powers designed the study, analyzed data, and was a primary author of the paper. Robinson provided interpretation of results and was a primary author of the paper. Berchick designed the social determinants of health framework for Aim 1 and edited the paper. Branham analyzed data for Aim 1, Dalzell designed the study, provided project oversight, wrote Aim 2, and edited the paper. Dennis analyzed data and wrote Aim 2. Eckerson wrote Aim 2. Gottschalck provided project oversight and edited the paper. Motro analyzed data and wrote Aim 2. Posey analyzed data for Aim 1. Verdon designed the visit classification system. Udalova managed the project, designed the study, provided project oversight, and edited the paper.

Abstract

Preventable emergency care generates excess costs for the public, increases provider burden for emergency departments (EDs), and may lower the quality of care for patients. EDs also bear costs associated with responding to sometimes duplicative requests about their data. However, to date there has not been much research in linking individual-level survey data with ED data to evaluate predictors of preventable ED visits, or in leveraging existing ED data to directly fulfill survey data requests. This work analyzes linked Utah Department of Health Emergency Department Encounters (UDOH ED) data and American Community Survey (ACS) data to report about relationships between preventable emergency care and social determinants of health (SDOH). This work also tests the feasibility of using UDOH ED data to replicate National Hospital Ambulatory Medical Care Survey Public Use File (NHAMCS PUF) tables. We find that most SDOH tested are significantly associated with preventable emergency care visits in Utah, and 15 of 27 NHAMCS PUF tables are replicable with these Utah ED data. Our findings can support efforts to reduce the extent of preventable emergency care and to boost ED cost-effectiveness, perhaps by informing health and healthcare-related strategies and/or policies. Our findings can also help with efforts towards reducing NHAMCS respondent burden and cutting costs associated with NHAMCS data collection.

David Powers, *Economist*
Social, Economic, and Housing Statistics Division (SEHSD), U.S. Census Bureau

Sara Robinson, *Survey Statistician*
Social, Economic, and Housing Statistics Division (SEHSD), U.S. Census Bureau

Edward Berchick, *Survey Statistician*
Social, Economic, and Housing Statistics Division (SEHSD), U.S. Census Bureau

J. Alex Branham, *Survey Statistician*
Social, Economic, and Housing Statistics Division (SEHSD), U.S. Census Bureau

Lucinda Dalzell, *Program Manager*
Demographic Directorate, Demographic Programs-Survey Operations**,** U.S. Census Bureau

Lorelle Dennis, *Survey Statistician*
Demographic Directorate, Demographic Programs-Survey Operations**,** U.S. Census Bureau

Kristi Eckerson, *Health Informatics Contractor*
Demographic Directorate, Demographic Programs-Survey Operations**,** U.S. Census Bureau

Alfred Gottschalck, *Assistant Division Chief*
Social, Economic, and Housing Statistics Division (SEHSD), Small Area and Longitudinal Estimates, U.S. Census Bureau

Joanna Motro, *Survey Statistician*
Demographic Directorate, Demographic Programs-Survey Operations**,** U.S. Census Bureau

John Posey, *IT Specialist*
Social, Economic, and Housing Statistics Division (SEHSD), U.S. Census Bureau

Andrew Verdon, *Economist*
Social, Economic, and Housing Statistics Division (SEHSD), U.S. Census Bureau

Victoria Udalova, *Research Economist and Enhancing Health (EHealth) Data Program Manager*
Demographic Directorate, Demographic Programs-Survey Operations**,** U.S. Census Bureau

Executive Summary

Preventable emergency care is a leading reason for emergency department (ED) visits in Utah (U.S. Census Bureau, 2018a). Preventable ED visits may result in excess costs for the public, increased patient burden for EDs, and poorer quality of care for patients (Anderson et al., 2007; Axelson et al., 2017; Baker & Baker, 1994). EDs also bear the cost of responding to sometimes duplicative requests about their data. Despite these difficulties, there has not been much research in linking individual-level survey data with ED data to evaluate predictors of preventable ED visits or in examining potential cost savings from using existing ED data to directly fulfill survey data requests (Crilly et al., 2011; Cheng & Phillips, 2014).

In this research, we combine data from the Utah Department of Health Emergency Department Encounters (UDOH ED) and data from the Census Bureau's American Community Survey (ACS), for years 2013 through 2017, in order to address two aims: 1) to examine social determinants of emergency department utilization in order to reduce "Preventable Emergency Care" visits (defined as ED visits that are "Non-emergent," "Primary Care Treatable," or "Preventable") in Utah; and 2) to evaluate the utility of ED encounter data for surveys for which the U.S. Census Bureau collects data (Billings et al., 2000a; Billings et al., 2000b). Aim 1 improves our understanding of the relationship between sociodemographic and economic characteristics and Preventable Emergency Care. Aim 2 tests the feasibility of replicating National Hospital Ambulatory Medical Care Survey Public Use File (NHAMCS PUF) tables with UDOH ED data.

For Aim 1, we analyze a linked file containing ED and ACS data from Utah residents who visited an ED and completed an ACS interview at any point between 2013 and 2017 (UDOH, 2017; U.S. Census Bureau, 2019a). We use the Social Determinants of Health (SDOH) framework and the New York University ED Algorithm (NYU ED Algorithm) to select a set of individual-level characteristics and classify ED visits into Preventable Emergency Care or non-Preventable Emergency Care, respectively (WHO, 2020; Billings et al., 2000a; Billings et al., 2000b). We present descriptive statistics and regression analyses to identify significant relationships between person characteristics and the likelihood of having one or more preventable ED visits. For Aim 2, we preprocess the 2017 UDOH ED data to resemble the NHAMCS inputs and recreate each NHAMCS PUF table based on table-specific methodologies.

For Aim 1, most SDOH are significantly related to, or predict, Preventable Emergency Care visits. For example, individuals in lower household income deciles tended to have more preventable ED visits than their counterparts in higher earning deciles. A similar relationship exists for education; individuals with lower educational attainment tended to have more preventable ED visits. Also, women made significantly more preventable ED visits than men. Finally, individuals with any disability made significantly more preventable ED visits than those without a disability. For Aim 2, the majority of the NHAMCS PUF tables (15 of 27) are partially or fully replicable. We believe that even more tables could be replicable if additional UDOH ED variables were available.

We conclude that the ED data from UDOH can be enhanced with survey data from ACS and NHAMCS, and vice versa, to support insights into SDOH. Moreover, there is significant value from attaching SDOH characteristics at the individual rather than the aggregate geographic level, and from doing so on a large scale. Specifically, we find the majority of SDOH are significantly associated with Preventable Emergency Care visits (Aim 1), and the majority of NHAMCS tables are replicable (Aim 2). These results can potentially be used to inform health and healthcare-related strategies and policies aimed at reducing Preventable Emergency Care visits and boosting program cost-effectiveness. In addition, these results may help towards reducing NHAMCS respondent burden and towards cutting NHAMCS costs related to administration, data collection, and data management.

Table of Contents

List of Tables

Aim 1[2]: Improve understanding of social determinants of emergency department (ED) utilization in Utah

Aim 2[3]: Evaluate the utility of ED encounter data for use with Census Bureau survey collections

[2] Please note that the table numbers do not correspond to the section numbers.

[3] Aim 2 table numbers reflect the specific NHAMCS PUF tables that can be replicated with UDOH ED data. Tables that are not listed could not be replicated.

List of Figures

Evaluating the Utility of Emergency Department Encounter Data and Examining Social Determinants of Emergency Department Utilization in Utah

1 Introduction

In 2019, the U.S. Census Bureau entered into a partnership agreement with the Utah Department of Health (UDOH) with two aims: 1) to improve understanding of the social determinants of emergency department (ED) utilization in Utah with the goal of identifying factors that may help to reduce "Preventable Emergency Care" visits (defined as ED visits that are "Non-emergent," "Primary Care Treatable," or "Preventable") (Billings et al., 2000a; Billings et al., 2000b; Billings et al., 2000c); and 2) to evaluate the utility of ED encounter data for use with Census Bureau survey collection. In this project, we link ED encounter data from the UDOH with surveys from the Census Bureau to assess social determinants of health and to categorize ED visits. This work uniquely attaches social determinants of health (SDOH) at the individual rather than aggregate geographic level and on a scale larger than previous work on these determinants. We also adapt the ED encounters data to match National Hospital Ambulatory Medical Care Survey (NHAMCS) inputs in order to assess the feasibility of creating Public Use File (PUF) tables from this dataset.

For Aim 1, we link the UDOH's ED data with non-publicly available American Community Survey (ACS) information to study the relationship between person and household characteristics and the likelihood of preventable and non-preventable ED visits. This linked dataset provides unique context regarding preventable ED visits, facilitating insights that could help lead to ED cost savings and improved health and healthcare outcomes in Utah (WHO, 2008). It also allows for validation of the Census Bureau's ACS survey content, since grouping the ED visits by ACS question responses is helpful for assessing the quality of ACS measurement by topic.[4] Aim 1 deliverables include graphs showing ED visits stratified by SDOH (see Appendix A) and a disclosure-proofed interactive dashboard to access cross-tabulations of ED visits data.

For Aim 2, we filter and tabulate the UDOH ED dataset to match the concepts and published tables produced using the National Hospital Ambulatory Medical Care Survey (NHAMCS), which is collected by the Census Bureau under sponsorship by the National Center for Health Statistics (NCHS) (https://www.cdc.gov/nchs/ahcd/index.htm). The successful recreation of some NHAMCS content from Aim 2 could potentially reduce provider respondent burden and create cost savings with respect to survey design, management, and data collection. Aim 2 deliverables include the NHAMCS tables that were replicable with UDOH ED data (see Appendix B).

The vision for this partnership emerged from a meeting hosted by the Census Bureau in April 2017 to explore how existing data could be used in new ways to support insights into the social determinants of health. Attending the meeting were representatives from organizations such as state health departments, state and regional health information exchanges, the Department of Health and Human Services' Office of the National Coordinator for Health IT, the National Center for Health Statistics, and

[4] For example, prior research documents higher preventable ED usage amongst females, Black individuals, and those with lower incomes (see Uscher-Pines, et al., 2013). We find that the linked UDOH ED-ACS dataset supports these predictions, and this lends credibility to the ACS measurement and reporting about these and other person and household characteristics.

the Census Bureau. Collectively, we recognized the potential for matching data collected by the Census Bureau with clinical health data to improve understanding of the socioeconomic dynamics that impact health. We discussed variables that are available through Census Bureau data, including race and Hispanic origin, household composition, generational dynamics, income, insurance status, education, transportation, housing, participation in safety net programs, and others. We were encouraged by the level of interest and the prospects for creating data products that support research in this area.

Since that initial meeting in April 2017, the U.S. Census Bureau has been developing a new program called Enhancing Health Data or EHealth. As part of EHealth, our team utilizes existing survey and administrative records data and engages with new stakeholders to acquire health records. The goal of these efforts is to improve the quality and availability of statistical information to better understand and advance population health. The Census Bureau collects survey data and maintains administrative records data from state, federal, and third-party sources containing a variety of individual-level demographic, socioeconomic, housing, transportation, and labor market characteristics. Our existing data linkage infrastructure facilitates individual-level linkages across data sources and over time. These assets have the potential to reduce respondent burden and data collection costs while increasing the quality of existing data. EHealth seeks to achieve these goals by assessing the quality of existing data, enhancing survey data products supplemented with health information, producing new data products, and allowing researchers to answer important and relevant questions that advance our knowledge of the socioeconomic dynamics affecting health. During the COVID-19 pandemic, these kinds of new data and statistics and related research questions have become even more crucial.

Immediately after the meeting in April 2017, representatives from the Utah Department of Health, led by Dr. Wu Xu and Dr. Navina Forsythe, and the Census Bureau's EHealth team championed by the Assistant Director for Demographic Programs, Eloise Parker, began to build a new partnership. Together we have worked through legal, policy, and security requirements and have succeeded in negotiating a tightly scoped exploratory project focused on the link between demographic, social, economic, and housing factors and ED visits in Utah to reduce preventable or avoidable emergency department utilization. Our hope is that the findings from this collaborative project will inform efforts to reduce costs related to ED visits for non-emergent issues and will improve our understanding of the broader role that the context of people's lives plays in health outcomes.

To meet our objectives, we entered into an agreement for the Census Bureau to bring over select variables from UDOH's identified ED Encounter data and link them to the ACS. The work under this agreement differs from most of the existing literature (for example, Krieger et al., 2003; Kind et al., 2014; Sills et al., 2016) and is innovative because it uses health records to attach social determinants of health at the individual rather than aggregate geographic level. This association has rarely been done before in part due to the challenges of accessing and linking individual-level health records with individual-level SDOH information. The linked dataset from Aim 1 provides unique context regarding preventable ED visits, facilitating insights that could help lead to ED cost savings and improved healthcare and health outcomes in Utah. It also allows for validation and improvement of ACS survey content. Additionally, linkage of these two data sources allows for creation of new estimates related to SDOH in the ED setting, contributing to the mission of the U.S. Census Bureau to serve as the nation's leading provider of quality data about its people and economy. By describing the characteristics of Utah's ED population, this project augments the Census Bureau's existing publications to provide more complete and relevant data products. The successful recreation of some NHAMCS content from Aim 2

could ultimately allow the NCHS, as a Census Bureau survey sponsor,[5] to reduce provider respondent burden and create cost savings in NHAMCS survey design, management, and data collection. It could also be an opportunity to publish NHAMCS content at sub-national levels of geography.

This partnership agreement also addresses unmet research needs for both UDOH and the Census Bureau and provides information about the cost-effectiveness of ED visits. Although UDOH collects statewide healthcare information, including ED visit data, measures on person and household characteristics are limited quality. The nature of the UDOH data limits the research questions that can be answered with existing UDOH data alone. Similarly, the Census Bureau's ACS does not cover healthcare utilization or health outcome measures, limiting research in the area of social determinants of health. Linking UDOH data with the Census Bureau's ACS, a leading source for detailed population and housing information, enriches both data sources. As we show in this paper, applying statistical analysis to the combined dataset reveals important data trends not observable from studying the UDOH ED data or ACS alone. These findings could help develop new strategies and methods to reduce Preventable Emergency Care visits in Utah, so that costs associated with ED overutilization in Utah are reduced. Some examples of these strategies and methods are prioritizing and targeting certain areas and/or groups with medical resources and public health messages. Additionally, these findings may be of relevance to policymakers seeking evidence regarding the impact on health and cost from policies related to healthcare and other topics.

Although the Census Bureau provides robust data for social, demographic, and economic characteristics, including self-reported health status, disability status, and health insurance coverage, its major surveys like the ACS, Current Population Survey Annual Social and Economic Supplement (CPS ASEC), and Survey of Income and Program Participation (SIPP) collect only limited data on health outcomes and clinical measures. These data gaps limit the kinds of estimates of population characteristics that can be produced and the research questions that can be answered with existing Census Bureau data. Under this agreement, by linking ACS data with UDOH ED encounters data, the utility of the existing Census Bureau data is expanded, especially given how an individual's health is linked to many other aspects of a person's life (WHO, 2008). Moreover, the linked dataset enables study regarding the nature and quality of ACS sociodemographic data. By examining the relationships between ACS sociodemographic characteristics and individual health outcomes (as inferred from ED visits in this case) the Census Bureau can learn more about the relative strengths and weaknesses of its collected ACS data.

Finally, using the UDOH ED dataset to replicate NHAMCS content could ultimately help to reduce survey respondent burden from healthcare providers. In addition, collection costs for the NHAMCS may be reducible if these data can be used in place of existing survey design and implementation activities within the state of Utah.

The deliverables for this joint proposal consist of this report text, charts and tables of aggregated results related to SDOH and ED visits and patients, and regression results from models considering the SDOH relationships simultaneously. The U.S. Census Bureau reviewed this data product for unauthorized disclosure of confidential information and approved the disclosure avoidance practices applied to this release, with the following clearance number: CBDRB-FY20-362. The Utah Department of Health and the National Center for Health Statistics also reviewed and approved this paper for release. Please see Appendix C for more information about the data security and privacy processes followed for this project.

[5] The U.S. Census Bureau, acting as a designated agent, conducts NHAMCS data collection on behalf of NCHS.

UDOH and the Census Bureau jointly agreed to a system of data confidentiality, system security, and disclosure avoidance (DA) policies that protects the data. These policies essentially restrict access to the data, secure the stored data, and ensure that released products do not contain any publicly identifiable information. Please see Appendix C for more information about the data security and privacy practices processes followed for this project.

The first section of this report discusses meeting Aim 1's goal for improving our understanding of the social determinants of ED utilization in Utah. The second section of this report discusses Aim 2, which is an examination of how Utah's data might benefit NHAMCS by reducing respondent burden.

Aim 1: Improve understanding of social determinants of emergency department (ED) utilization in Utah

2 Introduction

Emergency departments (EDs) constitute a major source of healthcare in the United States. In 2017, Americans made an estimated 139 million visits to EDs [National Center for Health Statistics (NCHS), 2018]. In recent years, EDs nationally averaged 414 visits per 1,000 persons in 2008, 428 visits per 1,000 persons in 2010, 451 visits per 1,000 persons in 2014, and 433 visits per 1,000 persons in 2017 (NCHS, 2009; NCHS, 2011; NCHS, 2015; NCHS, 2018). Among all ED visits, some are for preventable emergency care, some are for non-preventable emergency care, and some are for other reasons.

Using medical emergency resources for preventable emergency care can have negative impacts at the patient, physician, and facility levels. For example, patients may have longer wait times for care, and thus lower satisfaction with patient-provider interactions (Anderson et al., 2007; Bluestein et al., 2014). Physicians could experience greater frustration and distress (Axelson et al., 2017) due to greater patient load and patient recidivism. Additionally, ED visits cost more than non-ED visits for the same diagnosis (Baker & Baker, 1994); this excess cost may result in greater expenditures for patients seeking preventable emergency care and the facilities that treat these patients.

These negative effects associated with ED use for preventable emergency care motivate research to better understand the factors associated with ED visits. In this spirit, the purpose of Aim 1 is to use a Social Determinants of Health (SDOH) framework to assess patterns of preventable emergency care visits (CDC, 2020). We describe the data and perform simple bivariate analyses and logistic regressions[6] in order to examine whether ED visits were patterned across established Social Determinants of Health (e.g., income, employment status) [Centers for Disease Control and Prevention (CDC), 2010; World Health Organization (WHO), 2008]. We find strong relationships between the ED visits and SDOH factors that are consistent with expectations from the health literature.

3 Data

3.1 Utah Department of Health (UDOH)

All licensed hospitals and ambulatory surgical centers in Utah are required to provide data to the Office of Health Care Statistics (OHCS), part of the UDOH (Utah Department of Health, 2017). The providers collect the data and submit them to the OHCS on a quarterly basis. The UDOH collects a wide range of information on ED visits, including basic demographic information about the patient, information about the payer, reasons for the ED visit, diagnosis codes using the International Classification of Disease (ICD) codes, and the cost of the visit (Utah Department of Health, 2018).[7]

The Census Bureau obtained a file of roughly 3.6 million records from the UDOH (Utah Department of Health, 2017). Each record represents one ED visit between 2013 and 2017 in the state of Utah, and a

[6] We do not assess causality in this research.

[7] A codebook is here: https://gitlab.com/UtahOHCS/HFD_DUM/blob/master/Utah_HFD_Data_User_Manual.md

patient with multiple visits will have multiple records. These records represent all ED visits from the 49 hospitals in Utah during that timeframe. In the processing at the Census Bureau, each patient was assigned a unique identifier called a Protected Identification Key (PIK), which is discussed further in Section 4.1. The number of ED visit records and unique individuals are reported in Table 1-1. The number of visit records ranged from a low of 683,500 in 2013 to a high of 756,400 in 2016. The greatest number of unique individuals was reported in 2016 and the lowest was reported in 2013 (457,000 vs. 410,600). Average visits per person were lowest in 2013 (1.3 visits), and highest over 2014, 2015, and 2016 (1.7 visits). The median number of ED visits by person was 1.0 visit across all five years, but the average is greater because some people made several visits. The average number of visits across all five years by person was 2.5 visits.

Table 1-1. Descriptive Statistics of PIKed UDOH Sample, 2013-2017

Year	Number of ED visits	Number of unique persons	Average Visits per person
2013	683,500	410,600	1.7
2014	710,400	424,800	1.7
2015	737,500	442,400	1.7
2016	756,400	457,000	1.7
2017	736,100	453,000	1.6
Total	3,624,000	1,430,000	2.5

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018).

3.2 The American Community Survey (ACS)

The ACS is a leading source for detailed population and housing information for the U.S. and Puerto Rico; it is an ongoing sample survey that is collected on a monthly basis, and it replaced the decennial census "long form" post-2000 (U.S. Census Bureau, 2018b). The survey collects data about the social, demographic, economic, and housing characteristics of individuals and their households (U.S. Census Bureau, 2014). The health and health-care related topics addressed by the ACS are disability, fertility, and health insurance coverage (Census Bureau, 2020a).

About 3.5 million addresses are sampled annually (U.S. Census Bureau, 2014), and data collection follows a sequential mixed-mode design (U.S. Census Bureau, 2019c). The results of the ACS provide timely information about the characteristics of the nation to federal agencies, businesses, and individuals. The findings are used for planning, informational purposes, and the allocation of federal funding (Census Bureau, 2020b).

In this work, we use single-year ACS data for survey respondents residing in the state of Utah, for years 2013 through 2017; we note our source file is not the same as the five-year ACS file for 2013-2017. Our multiyear ACS Utah file contains roughly 375,000 person records, of which about 22,000 person records were unable to be assigned the unique Protected Identification Key (PIK) used by the Census Bureau.

3.3 Linked UDOH ED-ACS File

We merge the UDOH ED data with data from the American Community Survey (ACS) to meet the joint project goal of increasing understanding of ED visit patterns given measures of SDOH at the individual level. Details regarding the UDOH ED-ACS linking process are included in Section 4.1 further below.

As noted above, both the UDOH ED data and ACS span 2013 to 2017. Instead of requiring a match between the UDOH file and the ACS within a given year, we allow for matches outside of the calendar year, as long as both the ED and ACS record are within the 2013 to 2017 timespan. We believe this choice maximizes the number of linked records from the UDOH ED dataset (containing visits from years 2013-2017), while avoiding large differences in the time reference between the ACS data and the UDOH ED data. The final dataset had 230,000 records (or visits) made by 98,000 unique patients. The overall match rate was 6.5% at the visit level and 7.0% at the patient level. Please see Section 4.1, "Linking ACS Social Determinants of Health to UDOH ED Visits," for more detailed information about how the dataset was constructed.

3.4 The NYU ED Algorithm

The NYU ED Algorithm was created by a panel of ED and primary care physicians, many affiliated with New York University (Billings et al., 2000a; Billings et al., 2000b). They reviewed 5,700 emergency department cases from six hospitals in Bronx, New York City, for 1994 and 1999. The New York City hospitals used ICD-9 diagnosis codes for each visit. Each case contained information about patient medical history, age, vital signs, concerns, procedures undertaken, and the discharge diagnosis. The researchers excluded ED cases related to Mental-Health, Substance-Abuse, Alcohol, Injury, and some Unclassified codes. In recent years, some limitations of the Algorithm have gotten some attention, and there have been suggestions for improvement (Johnston et al., 2017; Lowe, 2017; Raven, 2015; Gonzalez Morganti et al., 2013).

Figure 1 depicts the NYU ED Algorithm's overall approach. Specifically, the Algorithm categorizes ED cases under the following process (Billings et al., 2000a). First, the Algorithm places cases into two categories: "Emergent" (cases requiring emergency medical care within the next 12 hours) or "Non-emergent." Second, it bifurcates the Emergent-case category: either the case requires ED care, or it can be treated by primary care. Third, it links patient symptoms to emergency department discharge diagnoses using ICD codes. Fourth, it determines which of the Emergent cases where ED care was needed were Preventable and which were Not Preventable. In our analyses, we exclude ED cases which do not fall under the Emergent or Non-emergent category including: Mental-Health, Substance-Abuse, Alcohol, Injury, and some Unclassified codes from the Algorithm.

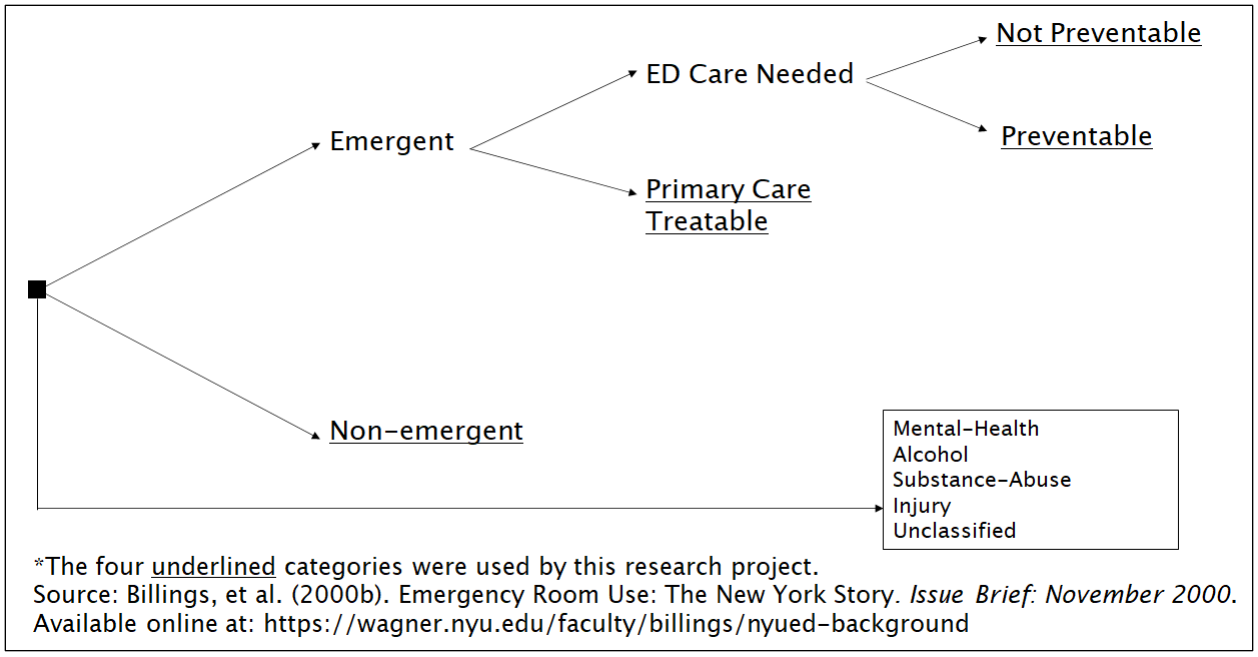

Figure 1. NYU ED Algorithm

The NYU ED Algorithm is widely used and has been repeatedly validated (Ballard et al., 2010; Gandhi & Sabik, 2014). For example, it has been used to classify emergency room visits from Medicare claims data (Joynt et al., 2013; Curto et al., 2019). Several papers provide estimates of the prevalence of ED cases by Algorithm category. The core NYU studies (Billings et al., 2000a; Billings et al., 2000b) estimate that Non-emergent cases make up 41.2-41.3% of all cases and 41.6-41.7% of all non-admitted cases. Some other studies have estimated the percentage of Non-emergent cases to be between 18% and 19.1% of all ED cases[8] (Miller, 2012; Johnston et al., 2017). Other works have combined Non-emergent and Emergent/ Primary Care Treatable together into one category. Estimates for this combined category, for example, are 49.2% (Gandhi & Sabik, 2014) and 47.8% (Ballard et al., 2010). Some other studies have focused on a subset of the original nine categories or created additional categories (Giannouchos et al., 2021; Lemke et al., 2020).

3.5 Assigning ICD Categories to the UDOH visit records

In order to classify the approximately 3.6 million UDOH ED visits received from Utah, covering 2013-2017, we apply the NYU ED Algorithm to the UDOH primary diagnosis code values in the UDOH file.[9] Specifically, noting the "Primary Diagnosis Code" field in the UDOH ED file follows ICD coding, we apply the Algorithm to the "Primary Diagnosis Code" field, which creates labels of any of the four Algorithm categories (namely, "Non-emergent," "Primary Care Treatable," "Preventable," "Not Preventable") for each ED visit.

[8] The denominator for these percentages includes all nine ED categories, rather than the four categories included in the current study.

[9] Other types of diagnosis codes were included in the UDOH ED data, but are not within scope for this research. Broadly, these codes are related to admission diagnosis, secondary diagnosis, and external causes of injury.

As a minor complication, around 2015, the diagnostic codebook shifted from the ICD-9 to the ICD-10 version (CDC, 2015). For 2013 through part of 2015, the UDOH data are based on ICD-9, while for the rest of 2015 through 2017, the UDOH data are based on ICD-10. But the NYU ED Algorithm codes are also published for ICD-10 as well as for ICD-9 (NYU, n.d.). We are able to bring the ICD-9 and ICD-10 code values together into a combined ICD-NYU lookup table, and then merge them, by ICD code, with the UDOH ED data using the ICD version code and the UDOH primary diagnosis code.

Using the combined lookup table, we are able to apply NYU ED visit categories to about 99.4% of the UDOH ED visits. Table 1-2 highlights the most frequent primary diagnoses in the UDOH ED file, coded through the Algorithm as either "Preventable Emergency Care" or "Not Preventable." Despite slightly different diagnoses named under ICD-9 and ICD-10, there is a lot of overlap in the results. For instance, for "Preventable Emergency Care," we find *other or unspecified abdominal pain* and *headache* both appearing within the top three diagnoses across ICD-9 and 10. Similarly, for "Not Preventable," we find *unspecified chest pain* and *syncope and collapse* appearing within the top three diagnoses across ICD-9 and 10.

Table 1-2. Top 5 Primary Diagnoses by ED Visit Type, 2013-2017

Type of Visit	Primary Diagnosis (with *Primary Diagnosis Code*)	
	ICD-9	ICD-10
Preventable Emergency Care*	• Abdominal pain, other specified site (*9:78909*) • Headache (*9:7840*) • Acute upper respiratory infections of unspecified site (*9:4659*) • Abdominal pain, unspecified site (*9:78900*) • Other chest pain (*9:78659*)	• Unspecified abdominal pain (*10:R109*) • Other chest pain (*10:R0789*) • Headache (*10:R51*) • Acute upper respiratory infection, unspecified (*10:J069*) • Low back pain (*10:M545*)
Not Preventable	• Chest pain, unspecified (*9:78650*) • Calculus of ureter (*9:5291*) • Syncope and collapse (*9:7802*) • Croup (*9:4644*) • Calculus of kidney (*9:5920*)	• Chest pain, unspecified (*10:R079*) • Syncope and collapse (*10:R55*) • Acute obstructive laryngitis [croup] (*10:J050*) • Calculus of kidney (*10:N200*) • Calculus of ureter (*10:N201*)

*Preventable Emergency Care visits are Non-emergent, Primary Care Treatable, or Preventable visits.

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018).

3.6 Handling ICD Codes with Multiple ED Categories

As discussed, in order to classify the UDOH ED visits as Preventable or Not Preventable, we apply the NYU ED Algorithm (Billings et al., 2000a, 2000b, 2000c) to the ED visits data; we are able to assign Algorithm categories for over 99 percent of the visits. However, some ICD codes are associated (in the NYU ED Algorithm) with more than one of the four ED categories simultaneously. To handle such ICD

codes, the Algorithm posts probabilities for each of the multiple ED categories,[10] which sum up to 100 percent for each ICD code.[11] Following previous studies, in this work we use a 50% probability cutoff to assign ICD codes to a category (Gandhi & Sabik, 2014; Ballard et al., 2010). That is, for a given ICD code, if the Algorithm assigns a 50% or higher probability of placement in a given category, then we classify the ICD code as being in that ED category. We also explored various thresholds, choosing 25%, 75%, and 90% in addition to 50%, but this did not materially change our findings. In the rare case that the Algorithm labels an ICD code with two categories having exactly 50% probability, we break the tie by randomly assigning one, applying a separate random assignment for each UDOH visit record.

Below we work through a detailed example to further illustrate how we handle the situation of multiple ED categories for a given ICD code. One can skip this optional example and go ahead to Section 3.7 without any trouble with following the next section's material. We use the example of *headache* (ICD-9 7840 and ICD-10 R51), which was among the most common diagnoses for Non-emergent and Preventable Emergency Care. As shown in Table 1-3, for this work, we studied using 4 different thresholds (25%, 50%, 75%, 90%) to see which might suit our analysis best. Taking these 4 thresholds across the 9 ED visit categories, the table contains 36 cells. The NYU ED Algorithm reports that 78% of headache cases are "Non-emergent," 9% "Primary Care Treatable," 0% "Care Needed – Preventable," and 13% "Care Needed – Not Preventable." Since 78% is greater than 25%, 50% and 75%, we entered "Yes" in the table, but since 78% is less than 90%, we entered "No" in the table there. This means that we would assign all headache cases to the "Non-emergent" ICD category as long as we used 25%, 50% or 75% as our coding threshold, but we would need to randomize our assignment of ICD category for headache cases if we instead used 90% as our coding threshold.

[10] Based on the 5,700 cases in the NYU ED sample, the Algorithm assigns the share of each primary diagnosis that falls into each of the four main visit-type categories. The physicians' coding of all patients' diagnoses are averaged to determine the assigned probabilities. Thus, the Algorithm is based on ex-post diagnoses, not ex-ante symptoms (Raven et al., 2013, Curto et al., 2019).
[11] For example, an ICD code could, hypothetically, be labeled as 40% Non-emergent and 60% Primary Care Treatable.

Table 1-3. Example of how the 'Headache' Primary Diagnosis was recoded

ICD Category	Percent from New York University Emergency Department (NYU ED) Algorithm	Recoding Threshold				Notes
		25%	50%	75%	90%	
Non-emergent	78%	**Yes**	**Yes**	**Yes**	No	Failed to meet the 90% threshold
Primary Care Treatable	9%	No	No	No	No	
Care Needed – Preventable	0%	No	No	No	No	
Care Needed – Not Preventable	13%	No	No	No	No	Failed to meet any threshold
Injury	0%	No	No	No	No	
Alcohol	0%	No	No	No	No	
Drug	0%	No	No	No	No	
Psychiatric	0%	No	No	No	No	
Unclassified	0%	No	No	No	No	
Total	**100%**					

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018).

The above *headache* example is fairly representative of the logic used to recode other UDOH data. By next applying this same approach for the full range of diagnoses, to all UDOH ED visit records in the UDOH file, we are able to compute the recoding percentages shown in Table 1-4.

Table 1-4. Recoding of the ICD Categories by Various Recoding Thresholds

NYU ED Category	Recoding Threshold				Notes
	25%	50%	75%	90%	
Non-emergent	25.7	20.0	8.5	3.0	
Primary Care Treatable	31.9	20.4	5.5	1.1	
Care Needed – Preventable	6.3	3.7	1.8	1.2	
Care Needed – Not Preventable	21.4	10.2	4.0	3.9	
Injury	23.9	23.9	23.9	23.9	Outside of scope of NYU ED Algorithm
Alcohol	0.9	0.9	0.9	0.9	Outside of scope of NYU ED Algorithm
Drug	0.6	0.6	0.6	0.6	Outside of scope of NYU ED Algorithm
Psychiatric	3.0	3.0	3.0	3.0	Outside of scope of NYU ED Algorithm
Unclassified	15.6	15.6	15.5	15.5	Outside of scope of NYU ED Algorithm

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018).

For example, by using a 50% threshold for the Non-emergent category, roughly 20% of all UDOH ED visits would be assigned as Non-emergent. We note the main four categories are each fairly sensitive to the recoding threshold, while the remaining five categories are not. This difference occurs because,

under the NYU ED Algorithm, only ICD codes for the four main ED visit categories are assigned more than one ED visit category simultaneously; the other five main ED visit categories are often assigned 100% or 0%. In this paper's analysis, we often focus on the first four NYU ED Algorithm categories (shaded grey), and we use a 50% recoding threshold (shaded blue). For the 50% threshold, adding up the first four categories, we compute 54 percent (i.e., 20.0+20.4+3.7+10.2) of ED visits, and adding up the lower five categories, we compute 44 percent of UDOH ED visits in the lower 5 categories.

As discussed earlier, consistent with other authors (Gandhi & Sabik, 2014; Ballard et al., 2010), in this work we use a 50% probability cutoff to assign ICD codes to a category. When we applied different thresholds (25%, 75% and 90%) to our processing as a test, they also worked fine, and we found that our results are essentially unchanged regardless of the exact threshold choice.

3.7 Profile of Utah and ED Patients

In this section, we compare the characteristics of UDOH ED patients relative to those in the overall Utah population (as determined by ACS state code), and relative to those in the overall U.S. population. We also compare the characteristics of UDOH ED patients having one or more Preventable Emergency Care visits relative to those of overall ED patients (i.e., those with any ED visit at all). In making these comparisons, we produce and use custom ACS estimates pooled together from ACS 1-year estimates from 2013 through 2017, and we use the custom linked 2013-2017 UDOH ED-ACS dataset described in Sections 3.3-3.6 above. Please note that, because these estimates are custom for our project, they do not match official ACS estimates due to differences in methodology, as expected (U.S. Census Bureau, 2018b; U.S. Census Bureau, 2018c; U.S. Census Bureau, 2018d; U.S. Census Bureau, 2018e).

Overall, given there is selection into the sub-populations (e.g., those with one or more ED visit, or those living in Utah), as compared to the broader populations, we expect there to be (and find) differences in ACS characteristics among these populations. Table 1-5 summarizes our findings, comparing the person- and household-level characteristics for Utah ED patients and preventable-ED patients relative to those of the overall Utah population.

Table 1-5. Comparisons Among Utah, ED Patients, and Preventable-ED Patients

Utah ED patients and preventable-ED patients, on average, have a…	higher **poverty rate**	***…than does the overall Utah population***
	higher **unemployment** rate	
	lower **educational attainment**	
	higher rate of **disability**	
	lower rate of being **married**	
	higher percent **female**	
	higher share that **receives SNAP benefits**	
	higher share that **lacks a vehicle**	

Table 1-6 drills down further, presenting estimates and margins of error for nineteen different social, economic, and demographic characteristics measured in the ACS, including information about the age universe applied for each concept. We find that ED patients (i.e., people with one or more visits to a Utah ED) tended to have fewer resources (e.g., income, home ownership, educational attainment, etc.) than the general Utah population. Moreover, ED patients with one or more Preventable Emergency Care visits tended to have fewer resources than the wider group of all ED patients. We also find that ED patients were more similar to their fellow Utah residents than to the broader U.S. population on average.

Table 1-6. Custom[12] Summary of Characteristics for the U.S., Utah, ED Patients, and Preventable-ED Patients

	Age Universe	**U.S. Population** (during 2013-2017)		**Utah Population** (during 2013-2017)		**Utahns with 1 or More ED Visits** (during 2013-2017)		**Utahns with 1 or More Preventable ED Visits** (during 2013-2017)	
		Estimate	*MOE*	*Estimate*	*MOE*	*Estimate*	*MOE*	*Estimate*	*MOE*
Population Size	All ages	321,000,000	165,400	2,988,000	2,448	987,600	5,984	508,800	4,870
Median Age (in years)	All ages	38.30	0.01	32.91	0.02	36.02	0.14	37.37	0.22
% of households w/1 or 2 persons	All ages	37.17	0.07	26.27	0.21	30.08	0.37	31.17	0.49
Marital Status - % Married	Ages 15+	47.68	0.08	55.58	0.38	54.42	0.50	53.68	0.63
Sex - % Female	All ages	50.79	0.04	49.67	0.05	51.96	0.30	57.15	0.39
Race - % White, non-Hispanic	All ages	61.66	0.02	79.12	0.11	79.75	0.29	77.40	0.45
Foreign Born (Nativity)	All ages	13.41	0.02	8.37	0.11	6.29	0.18	6.93	0.28
Education - % with B.A. or higher	Ages 25+	30.72	0.08	32.34	0.26	26.59	0.43	23.49	0.57
Disability Rate (Any Type)	Ages 15+	15.32	0.03	12.34	0.16	18.72	0.32	21.59	0.39
Poverty Rate	All ages	14.70	0.08	11.06	0.22	12.60	0.33	14.90	0.47
Unemployment Rate	Ages 16+	6.59	0.02	4.40	0.13	5.75	0.26	6.90	0.42
Uninsured Rate	All ages	10.87	0.06	11.18	0.18	10.07	0.31	11.11	0.46
Public Health Coverage Rate	All ages	34.28	0.05	21.29	0.22	30.48	0.41	34.99	0.59
SNAP Participation Rate	All ages	16.11	0.07	9.65	0.28	14.19	0.42	17.81	0.61
Home Ownership Rate	All ages	64.92	0.11	71.92	0.41	69.25	0.53	65.33	0.70
Veteran Status - % Past/Current Military Service	Ages 17+	7.90	0.01	6.10	0.10	7.36	0.17	7.20	0.28
Speaks English Less than "Well"	Ages 5+	4.49	0.02	2.44	0.08	1.52	0.12	1.74	0.18
Lack of Internet Access	All ages	13.44	0.07	7.21	0.18	8.91	0.31	10.60	0.47
Lack of Vehicle Access	All ages	6.50	0.02	2.44	0.10	3.24	0.15	4.03	0.26

Notes: The population size estimate is computed as the sum of the 5 years of population estimates (2013-2017) divided by 5.
Median household income is scaled to 2018 constant dollars because that was the most recent year when the project started.
The uninsured rate uses the total population, not the civilian, noninstitutionalized population.

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013-2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Below we narrate these Table 1-6 figures in greater detail, discussing groups of characteristics that have common comparison results. To simplify the text in this section, we use the phrase “preventable-ED patients” to connote people receiving Preventable Emergency Care, or, in other words, people who have

[12] The custom estimates provided in Table 1-6 are based on unpublished 1-year ACS data, and do not match official ACS estimates due to differences in methodology.

one or more preventable ED visits from any of the following 3 NYU ED Algorithm categories: Non-emergent, Primary Care Treatable, or Care Needed-Preventable.

Over 2013 through 2017, the U.S. population averaged around 321 million residents, and the Utah population averaged about 3.0 million residents. During the same time period, there are approximately 988 thousand Utah residents (i.e., Utahns) with one or more Utah ED visits, which is about 33% of the Utah population. There were approximately 509 thousand Utah residents with one or more preventable ED visits, which is about 17% of the Utah population, and is a little more than half of the number of Utah residents with one or more ED visits.

Utah ED patients, in comparison to the general Utah population, from 2013-2017, are older, are more female, have smaller households, and have a lower rate of being married on average. These patients also have a higher poverty rate and unemployment rate, and greater reliance on public health coverage and SNAP participation, when compared to Utah overall. Educational attainment is lower, and the share of people with a military background or disability is higher, when comparing Utah ED patients with Utah residents overall. Utah ED patients have slightly worse internet and vehicle access than Utah residents overall. Finally, a smaller share of patients does not speak English at least "well,"[13] and a smaller share are foreign born, when compared to the general Utah population. As a reminder, only successfully-PIKed records are included in these analyses.

Utah ED patients, in comparison to the national population, from 2013-2017, are younger, are more female, have smaller households, have a higher rate of being married, and have a higher rate of being non-Hispanic White. These patients also have a lower poverty rate and unemployment rate, less reliance on public health coverage, and lower SNAP participation, when compared to U.S. residents overall. Educational attainment is lower, and the share of people who own homes or have any disability is higher, when comparing Utah ED patients with overall U.S. residents. Utah ED patients have better internet and vehicle access than U.S. residents overall. In addition, a smaller share of patients does not speak English at least "well," and a smaller share are foreign born when compared to the national population.

Utah ED patients with one or more Preventable Emergency Care visits, when compared to general Utah ED patients, are more female, are less NH White, have lower educational attainment, and have a higher disability rate. These preventable-ED patients also have a higher poverty rate and rely more on public health coverage and SNAP participation than their counterparts of general Utah ED patients. These patients with Preventable Emergency Care visits also have a lower home ownership rate and have slightly less internet access than do general Utah ED patients.

Overall, Utah ED patients are more similar to Utahns than to the general U.S. population on average. Still, these Utah ED patients are somewhat disadvantaged compared to the general Utah population, in particular, having less access to a vehicle and to the internet.

[13] Patients who speak English at least "well" either speak English "well" or "very well."

4 Methodology

In this section we discuss the methods used to construct the linked dataset and perform statistical analyses for the 2013 through 2017 period.

4.1 Linking ACS Social Determinants of Health to UDOH ED visits

In order to attach the ACS SDOH variables with the UDOH ED visits, we link the files by unique person-level identifiers, called Protected Identification Keys (PIKs). These PIKs were assigned using the Person Identification Validation System (PVS), as described in Wagner and Layne (2014). The PVS uses probabilistic matching to assign PIKs based on social security numbers (SSNs), if available, and other information such as names, dates of birth, and addresses.

About 97% of UDOH ED visit records are assigned a PIK (3.5 million of the 3.6 million total ED visits). Approximately 77% of these records are assigned a unique identifier from their SSN. There are 1.4 million unique PIKs in the UDOH data, implying an average of 2.5 ED visits per ED patient over the five years of data. Approximately 95% of the ACS person records for 2013 through 2017 are assigned a PIK. All ACS records whose state of residence is Utah with a PIK are used when attempting the linkage with the UDOH ED data.

From the linkage of UDOH ED data and the ACS over 2013 through 2017, about 230,000 of the 3.5 million PIKed ED visits are matched to an ACS interview (6.5% match rate at the visit level). Approximately 98,000 of the 1.4 million unique PIKs identified in the pooled 2013-2017 ED data are matched to an ACS record (7.0% match rate at the patient level). Once UDOH records that failed to receive a PIK are excluded, the match rate at the visit level over 2013-2017 improves to over 7.0%.

As expected, the combined dataset contains duplicate PIKs corresponding to multiple ED visits for many patients. Only a very small number of the ED visit records (approximately 1%) appear to be duplicate visit records (having agreement along all fields in the UDOH ED file at the Census Bureau), but even these records may have differences on some other fields that Census Bureau did not receive. For this small set of apparently duplicate visit records, we keep only one randomly-chosen visit in our linked file to avoid double-counting.

When attempting to match the UDOH ED visits from a specific year over to any of the five years of ACS data, the year-specific match rates are near 7.0% for each of the five years. However, the match rate drops considerably if only ACS records from the same year as the UDOH ED visit are used (e.g., 1.3 % in 2017). Thus, many of the linked UDOH ED-ACS records borrow data from other years in the 2013-2017 period (e.g., links between 2014 UDOH data and 2016 ACS data). While many of the social and economic characteristics measured in the ACS are likely stable over time (e.g., sex, race/ethnicity, nativity [foreign born]), other characteristics more often change from year to year (e.g., household income, housing tenure, marital status), which makes using different years somewhat less reliable. We have chosen to use the five-year range 2013-2017 in the ACS data, in concert with the 2013-2017 UDOH records, as the right timeframe for balancing the benefits and drawbacks of having increased numbers of matches against the downsides of having “stale” or out-of-date information.

4.2 Social Determinants of Health Framework

The Social Determinants of Health (SDOH) framework theorizes that the conditions of an individual's environment impact their health (WHO, 2008). When these conditions are poor, an individual's health suffers. People navigate a variety of environments over their life course, including home, school, and work environments. A lack of access to quality or quantity of resources in these areas can have detrimental health impacts. Past research has supported the SDOH theory for a variety of health-related indicators, including wealth inequalities, healthcare use and cost, and health outcomes themselves (Poterba et al., 2018; Sterling et al., 2018; Ahnquist & Lindstrom, 2012). Some work has also tied SDOH to top reasons for ED visits, such as migraines (Li et al., 2019; Zock et al., 2018), pneumonia, and pneumonia-related complications (Victoria et al., 1992; Crighton et al., 2007; Scott et al., 2000).

We adapt the SDOH framework for Preventable Emergency Care visits and our linked dataset as follows. The SDOH we examine in this study are identified based on a review of public health and social epidemiological literature and data availability in the ACS (e.g., Behr & Diaz, 2016; Luo et al., 2012; U.S. Census Bureau, 2014). Consistent with the *Healthy People 2020* framework (CDC, 2020), our SDOH characteristics span five domains: Economic Stability, Education, Social and Community Context, Health and Healthcare, Neighborhood and Built Environment. Although data year is not a social determinant, it is included for comparative analyses across years.

Table 1-7 shows the full list of SDOH included in our study, with each SDOH depicted within its respective higher domain.

Table 1-7. List of Social Determinants by Domain

Economic Stability	Education	Social and Community Context	Health and Healthcare	Neighborhood and Built Environment
• Employment Status • Household Income Decile • Household Size • Poverty Status • SNAP Participation	• Ability to Speak English • Educational Attainment	• Age Group • Internet Access • Marital Status • Nativity • Race and Hispanic Origin • Sex • Current military or past (Veterans)	• Disability Status • Health Insurance Status • Public Health Coverage	• Vehicle Access • Housing Tenure

Source: World Health Organization (WHO), Commission on Social Determinants of Health (2008). Closing the Gap in a Generation: Health equity through action on the social determinants of health. Available online at http://www.who.int/social_determinants/en

We obtain our SDOH measures from the ACS (U.S. Census Bureau, 2020a). As such, the fixed definition of some variables in the survey can limit the population universe. We also manually apply some universe restrictions ourselves. The population universes for all of our determinants are shown in the second column of Table 1-6 of Section 3.7. Additional information about the ACS is included in Section 3.2.

4.3 Descriptive Analyses

Descriptive bivariate analyses are produced between the SDOH characteristics (e.g., Male/Female, Insured/Uninsured) and the number or percentage of ED visits. These statistics are purely descriptive in nature and do not imply causality. We report ED visits summarized across any of the nine NYU ED categories, as well as cross-tabulated by type of ED visit among the four main ED categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable). We apply the standard ACS 1-year person or household weights from our pooled five years of ACS files, and in some cases we divide by five in order to approximate estimates that are scaled for a single year. Our margins of error reflect the use of replicate weights to account for the complex sampling design (U.S. Census Bureau, 2014).

We compute the *average number of visits per 1,000 people* by dividing the weighted number of ED visits in the 5-year period (2013-2017) by the ACS weighted population estimate for Utah in the same 5-year period (i.e., the sum of all 5 years' population estimates together, which is roughly 15 million in total), and then multiplying by 1,000. Any linked ACS-UDOH ED records in which the ACS resident state code was not Utah (roughly 6% in total) are excluded from the analysis (U.S. Census Bureau, 2019b).[14]

We compute the *percentage of visits* for each type of ED visit by dividing the weighted number of linked ACS-UDOH ED visits for one category of a given ACS variable and for one of the four NYU ED Algorithm codes, by the sum of the corresponding visits for all four NYU Algorithm codes. To be consistent with the calculation above, only linked ACS-UDOH ED records in which the ACS state code was Utah were included in analyses.

4.4 Modeling

We fit logistic regression models to estimate the odds of having a preventable ED visit in Utah, controlling for many ACS-measured SDOH and other factors at once.

Three models are fit to the data using the social determinants as main predictors and some form of preventable ED visits as the response variable (see Table 1-8). These models are briefly described below.

- In Model 1, we predict the odds, given there was a Utah ED visit, that it was a Preventable ED visit. We use only the ED visits that can be linked with an ACS interview in Utah.
- In Model 2, we predict the odds, given someone visited a Utah ED, that this person had 1 or more Preventable ED visits. We use only the ED patients linked with an ACS interview in Utah.
- In Model 3, we predict the odds, given that someone lives in Utah, that a person has 1 or more Preventable ED visits. We use the data for all ACS interviews in Utah, whether or not they are linked to an ED patient.

[14] We do so because otherwise the denominator of the average visits per person would be ambiguous or undetermined since there were at least small numbers of ED visits from people residing in nearly all other U.S. states.

Models 1 and 2 use only the UDOH-ACS linked records, whereas, Model 3 also uses the unmatched ACS records from Utah. We use the terms "Preventable ED visits" or "Preventable Emergency Care" to connote visits that are classified by the NYU ED Algorithm as "Non-emergent," "Primary Care Treatable," or "Preventable." Please see the preceding NYU ED Algorithm section (Section 3.4) for more information about how ED visits are classified.

Table 1-8 describes the three regression models studied. In each model, we include the same SDOH microdata variables shown previously in Table 1-7 and later (in Section 5.1) examined descriptively. These SDOH are shown under the "Independent Variables" column of Table 1-8. As is typical with descriptive analyses, all estimates are weighted. Table 1-8 also provides unweighted counts and weighted total estimates for the data used in the regressions. These counts and estimates are based on pooling years 2013 through 2017 of ACS sample and using 1-year ACS weights; they are not based on the 5-year ACS data product and associated weights. The unit of measurement is "visit-years" for Model 1 and "person-years" for Models 2 and 3.[15]

[15] In order to estimate the number of ED visits, or number of Utah residents who had ED visits over the five-year period 2013-2017, one must divide Table 1.8's weighted estimates by five.

Table 1-8. Regression Models

Models	Variables		Visit, Patient, or Person Level?[16]	N*	
	Independent Variables	Dependent Variable		Unweighted	Weighted
Model 1	*Microdata Variables:* Ability to Speak English Vehicle Access Age Group ED Visit Year Disability Status Educational Attainment Employment Status Health Insurance Coverage Household Income Decile Household Size Housing Tenure Internet Access Marital Status Nativity Poverty Status (Family) Public Assistance Race and Hispanic Origin Sex SNAP Participation Current Military or Past (Veterans) ——— Month of the Year Day of the Week *County-Level Variables* % without Health Insurance % in Poverty % Non-White Population Unemployment Rate	ED Visit Preventable? (Yes/No) From Among All Utah ED Visits	Visit	135,000	8,380,000 (+/- 50,780)
Model 2		1 or More Preventable ED Visits? (Yes/No) From Among People Who Had 1 or More Utah ED Visit	Patient	53,200	3,050,000 (+/- 29,190)
Model 3		1 or More Preventable ED Visits? (Yes/No) From Among All Residents of Utah	Person	151,000	8,590,000 (+/- 51,540)

*N rounded to 4 significant digits per Census Bureau's disclosure avoidance rules.
Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013-2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Return to Section 5.4 (Regression Models) ↵

[16] These analyses are restricted to ACS-linked ED patients and visits in Utah. They do not include visit records of UDOH ED patients linked to ACS respondents *outside* of Utah, and they do not include ED visits or ED patients served in other states.

In order to capture local conditions and how they may affect the odds of an ED visit, we also include some area-level variables. Specifically, we include estimates of: the county-level poverty rate from Small Area Income and Poverty Estimates (SAIPE; U.S. Census Bureau, 2019d); the county-level uninsured rate from Small Area Health Insurance Estimates (SAHIE; U.S. Census Bureau, 2019e); the county-level unemployment rate from Local Area Unemployment Statistics (LAUS; Bureau of Labor Statistics, 2020); and percent of the county population that is White non-Hispanic from the 2010 Census (U.S. Census Bureau, 2011). These county-level estimates correspond to the county of residence from the respondent at the time of ACS interview (U.S. Census Bureau, 2019f).

In order to somewhat control for seasonality and weekday variation in the visits model (Model 1), we include an indicator for month of the ED visit (January through December) and an indicator for the day of the week for the ED visit (Sunday through Saturday). These seasonality and day-of-week indicators are not included for Models 2 and 3 because the patients in Model 2 can have multiple visits, and many people in Model 3 do not have an ED visit at all.

Of note, we do not include visit records for which the UDOH ED patient is linked to an ACS respondent outside of Utah. In addition, we do not observe whether an ACS respondent visited an ED in a different state. Also, the range of observations we can include in the regressions is constrained by the SDOH measures with the most restrictive universe, which happens to be the educational attainment variable, which we compute only for people ages 25 and over. As a result, people under age 25 are not included within the model fitting or model results we show here.[17]

Since our goal is to estimate the presence of relationships between the SDOH and ED visits, not to estimate the magnitude of net effects, we have kept our models and evaluations simple. As such, we report only overall model diagnostics and statistical significance for each SDOH, but not the estimated coefficients. Future work can refine these models to more fully explore and quantify the relationship(s) between SDOH and preventable ED visits.

[17] In order to check whether the age restriction for education was impactful to our findings, we separately tried including a category for "age <25" for educational attainment (and keeping all people in the model), and we tried dropping the education variable, and we noted no major differences in our findings as a result.

5 Aim 1 Results

In this section, we present results from our descriptive analyses and regression analyses on the linked UDOH ED-ACS file. Specifically, we report whether, for the 2013-17 period, there are significant differences in the number and percent of ED visits when compared across ACS characteristics. We consider tallies of all ED visits (from the nine NYU ED Algorithm categories) as well as breakouts of ED visits by the four main ED categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable). These findings are based upon the linked UDOH-ACS dataset, which combines the PIKed UDOH visit-level records with the matching, PIKed ACS interviews from the state of Utah.

Section 5.1 focuses on linkages between any year of ED visit and any year of ACS interview, and it shows summary statistics about ED visits by ACS characteristics. Moreover, Section 5.1 tests for differences across these characteristics to determine the existence of bivariate (gross) effects on ED visits. Section 5.2 takes the Section 5.1 results as a benchmark, and highlights any differences in trends due to constraining the linkages only for *matching* year between the ED visits and ACS interview (e.g., ED visits during 2014 with ACS interviews during 2014). Section 5.3 also takes the Section 5.1 results as a benchmark, and highlights any differences in trends from cross-tabulating these data by age group (0-18, 19-64, 65+). Finally, Section 5.4 presents results from our regression analyses, which include all SDOH factors and other variables together simultaneously. We report about the most important predictors from the models, which indicate multivariate (net) effects between ACS characteristics and ED visits, and we compare these with the bivariate (gross) effects studied in Section 5.1.

We here provide some context for the extent of ED use, by citing figures for the average visits per 1,000 people across several data sets. Using the concept of visits per 1,000 people, NCHS (2018) quotes a national figure for 2017 of 433 (+/-5.3), and NCHS (2018) quotes, for the West region, a figure of 318 visits (+/-8.9). Morning Consult (2020) quotes a figure for Utah in 2016 of 235 visits. By comparison, regarding the UDOH ED data used in this work, the non-linked, full file shows 249 visits for 2016, which is somewhat close to the Morning Consult (2020) figure for 2016, but lower than the NCHS (2018) West region figure for 2017. Regarding the linked, weighted UDOH ED-ACS file, we estimate 303 (+/-7.1) visits for 2016, which is higher than the figure for the corresponding non-linked UDOH ED file.

5.1 Descriptive Statistics

In this subsection, we present summary statistics across 19 SDOH and by year, related to the descriptive analyses described in Section 4.3, “Descriptive Analyses.” In “Appendix A: Aim 1 Figures,” located at the end of this work, we include two graphs for each SDOH: one measuring average visits per 1,000 people, and the other measuring the share of ED visits in each of the four main ED categories.

We include a separate subsection for each domain from the *Healthy People 2020* framework, namely: Economic Stability (Sec. 5.1.1), Education (Sec. 5.1.2), Social and Community Context (Sec. 5.1.3), Health and Healthcare (Sec. 5.1.4), and Neighborhood and Built Environment (Sec. 5.1.5) (WHO, 2020). Within each of these, we have yet further subsections pertaining to the specific social determinants within each domain, sorted alphabetically. A summary of the main findings is presented below in Table 1-9, which compares the groups of people who made more Preventable Emergency Care visits (i.e., Group 1) relative to their counterparts with fewer of such visits (i.e., Group 2).

Table 1-9. Main Findings for Social Determinants of Preventable Emergency Care Visits

Group 1	***vs.***	***Group 2***
Individuals in **lower income deciles**	…had **more preventable emergency care visits** than…	individuals in **higher income deciles**
Individuals who were **unemployed**		individuals who were **employed**
Individuals with **less educational attainment**		individuals with **more educational attainment**
Individuals with **one or more disabilities**		individuals with **no disabilities**
Individuals who were **divorced/separated/widowed**		individuals who were **married** or **never married**
Women		**men**
Individuals living in **renter-occupied housing**		individuals living in **owner-occupied housing**
Individuals **without Internet access**		individuals **with Internet access**

As a benchmark regarding overall UDOH ED use, we note that there are 1,521 (+/- 16.1) visits per 1,000 people on average within the full linked UDOH ED-ACS file, over 2013 through 2017, across all ED visit categories. When limited to just the four main ED categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable), there are 449 (+/-8.3) visits per 1,000 people on average. Finally, when limited to just the three Preventable Emergency Care categories, there are 360 (+/-1.6) visits per 1,000 people on average.

5.1.1 Economic Stability

5.1.1.1 Household Income Deciles
(All ages at the time of the ACS interview; household-level variable)

Our primary measure of economic conditions and stability is **household income** during the past 12 months. To increase comparability across years (over 2013 to 2017), we inflation-adjust income by the Consumer Price Index Research Series (CPI-U-RS) (Bureau of Labor Statistics, 2020) to correspond to 2018 dollars. Moreover, we compute the income percentile rank to study the income data by decile.

Similar to past research linking relative income with health behaviors, healthcare access, and health outcomes (Glymour, Avendano, & Kawachi, 2014; Sun et al., 2003; Wildman, 2001), higher levels of household income were associated with lower ED utilization overall. We saw evidence of an income gradient in ED use between the first and fifth decile, which flattens at higher incomes. During the 5-year period, individuals in the lowest income decile made 50% more visits (2,038 visits per 1,000 people) than individuals in higher income deciles (9^{th} decile = 1,339 visits per 1,000 people).

When limiting to just Preventable Emergency Care visits, we find that individuals in higher income deciles had fewer Preventable Emergency Care visits than those in lower income deciles (see Figure 2 of Appendix A). Once again, we generally observe an income gradient. Those in the lowest decile made almost three times as many Non-emergent and Primary Care Treatable visits than those in higher deciles. These findings are qualitatively in line with those from Saruda et al. (2006). Conversely, the share of Not Preventable visits is higher in the first income decile than in the fifth income decile (see Figure 3 of Appendix A). Likewise, the share of Not Preventable visits is higher in the fifth income decile than in the ninth income decile.

5.1.1.2 Employment Status
(Aged 16 or older at the time of the ACS interview; individual-level variable)

Another core measure is **employment status** (employed, unemployed, in the armed forces/not in the labor force during the last week). Past research finds that employment status is associated with access to healthcare and health outcomes (e.g., Behr & Diaz, 2016; Meyerhoefer & Pylypchuk, 2008).

Unemployment is associated with greater ED utilization overall. Individuals who were unemployed made about 1.7 times as many ED visits as those that are employed. Individuals who were unemployed made the most visits, followed by those that were in the armed forces or not in the labor force, and then those that were employed. Specifically, during the 5-year period we study, individuals who were unemployed at the time of ACS interview made 2,334 visits per 1,000 population, in the armed forces or not in the labor force made 1,931 visits, and employed made 1,404 visits. Among all SDOH, the most common types of ED visit are Non-emergent and Primary Care Treatable, followed by Not Preventable, and Preventable visits, respectively.

When limiting to just Preventable Emergency Care visits, we find that individuals who are unemployed have more Preventable Emergency Care visits than those who are employed, and those who are in the armed forces or not in the labor force (see Figure 4 of Appendix A). Unemployment is associated with higher rates of all types of ED visits compared with employment (Utah Unemployment Rate = 4.4%). Individuals who were unemployed made almost twice as many Non-emergent visits as those who were employed. In contrast, employed persons made up the highest percentage (i.e., share) of Not Preventable ED visits (see Figure 5 of Appendix A).

5.1.1.3 Poverty Status
(All ages at the time of ACS Interview; household-level variable)

Poverty is related to a greater likelihood of poor health outcomes and more non-emergent ED visits (Turney et al., 2013). Similar to past research, we find that ED visits vary by poverty status. For this research, poverty is defined as the ratio of an individual's income to the federal poverty threshold for his or her family size.

Looking at ED visits overall, individuals living in poverty make more ED visits than those not in poverty. Those living in poverty made almost 1.5 times as many ED visits on average than their counterparts. Specifically, individuals not living in poverty made 1,454 visits and individuals living in poverty made 2,057 visits per 1,000 people.

When limiting to just Preventable Emergency Care visits, we find that individuals in poverty have more Preventable Emergency Care visits than those not in poverty (see Figure 6 of Appendix A). On average, people living in poverty made more than twice as many Non-emergent and Primary Care Treatable visits as those not in poverty (Utah Poverty Rate = 11.1%). This finding replicates past work, in which the neighborhood poverty level was related to a larger number of non-emergent ED visits (Jiang, et al., 2014). Individuals from households in poverty also made more Not Preventable visits on average than their counterparts not in poverty. Conversely, individuals not in poverty comprise a larger share of Not Preventable visits (see Figure 7 of Appendix A).

5.1.1.4 Household Size
(All ages at the time of the ACS interview; household-level variable)

Household size is also related to the resources to which an individual may have access (e.g., Organization for Economic Collaboration and Development [OECD], 2008). We examine ED visits by household size, with groupings for sizes 1, 2, 3-5, 6-9, and 10 or greater.

Looking at all ED visits, individuals in smaller households tend to have more ED visits than those in larger households. The average number of visits was highest for individuals in single-person households (1,748 visits per 1,000 people) and among the lowest for individuals in households with 6-9 members (1,411 visits) per 1,000 people.

Individuals in smaller households have more Preventable Emergency Care visits than those in larger households (see Figure 8). On average, all types of visits were generally highest among households with few members and least in households with many members (Percent of Households with 1 or 2 Persons in Utah = 26.3%). Similarly, the share of Not Preventable visits is greatest among small households and least among the larger households (see Figure 9). These findings are consistent with past research, which associates loneliness with poorer self-rated health and increased functional limitations among older adults (Luo et al., 2012).

5.1.1.5 SNAP Participation
(All ages at the time of the ACS interview; household-level variable)

We examined **program participation** with an indicator for SNAP receipt during the past 12 months. SNAP eligibility is based on income, family size and assets (and sometimes by employment status) (USDA FNS, 2021).

Consistent with prior research, program participation is associated with health and healthcare-seeking behaviors (e.g., Behr & Diaz, 2016; Meyerhoefer & Pylypchuk, 2008). Individuals in households that receive SNAP benefits make more ED visits on average. Individuals in SNAP households made approximately 2,564 visits per 1,000 people, while individuals in households not receiving SNAP benefits made 1,410 visits per 1,000 people over the five-year study period.

Individuals in SNAP households also have more Preventable Emergency Care visits than those in non-SNAP households (see Figure 10). They also made about three times as many Non-emergent and Primary Care Treatable visits as individuals not receiving benefits. Individuals in SNAP households made nearly twice as many Not Preventable visits as their counterparts (SNAP Participation Rate in Utah = 9.6%). However, individuals in households not receiving SNAP benefits make a higher share of Not Preventable visits (see Figure 11) than individuals in SNAP households.

5.1.2 Education

5.1.2.1 Educational Attainment
(Aged 25 or older at the time of ACS Interview; individual-level variable)

The ACS measures the **highest level of education** that individuals have completed. We focus on major degrees for ease of interpretability and have restricted analyses of education gradients to adults aged 25 and older, as younger individuals may have not finished attaining more education.

As previously found in educational attainment and healthcare utilization research (Huntley et al., 2014; Arendt, 2008; Sun et al., 2003), we find evidence of an education gradient in ED visits. Similar to household income and this past research, individuals with lower education attainment use the ED more frequently than those with higher attainment. Specifically, ED visit rates ranged from a high among those with less than a high school diploma (2,041 visits per 1,000 population) to a low among those with a bachelor's degree or higher (1,296 visits per 1,000 people).

Individuals with lower educational attainment make more Preventable Emergency Care visits than those with higher educational attainment (see Figure 12). On average, people with less than a high school diploma made three times as many Non-emergent ED visits as individuals with a Bachelor's degree or higher. Individuals with lower educational attainment also made more Not Preventable ED visits on average than those with more educational attainment, excluding those with some college education (Percent with a Bachelor's degree or Higher in Utah = 32.3%). Another gradient appeared for the share of Not Preventable visits; those with less attainment accounted for a smaller share of these visits than their more educated counterparts. Individuals with a bachelor's degree or higher comprised almost twice the share of Not Preventable visits in comparison to those with less than a high school diploma (see Figure 13).

5.1.2.2 Ability to Speak English
(Aged 5 or older at the time of ACS Interview; individual-level variable)

The *Healthy People 2020* framework considers **language** as an education-related social determinant of health (CDC, 2010). Therefore, we examine the association between whether a person speaks English well ("well," "very well," or "exclusively") or less than well ("not well" or "not at all") and ED visits. The original 5 categories were collapsed into 2 larger groups due to small cell sizes in the data.

We find that people who speak English well use EDs more than those who do not. Individuals who speak English well made 1,537 visits per 1,000 people compared with 1,265 visits per 1,000 population by those who speak English less than well. As with the other SDOH, only PIKed ACS records and PIKed UDOH records that link together by PIK are used in our Section 5.1 analyses.

Individuals who speak English well have more Preventable Emergency Care visits than those who speak English less than well (see Figure 14). On average, people who speak English well made about 1.5 times as many Non-emergent and Primary Care Treatable visits per capita as those who speak English less than well (Percent who Speak English Less Than Well in Utah = 2.4%). These findings (which use only PIKed records) are qualitatively different from Kilfoyle et al. (2017), which found, among pregnant women, greater odds of nonurgent ED use to be associated with having a preferred language other than English.

Individuals who speak English well made about twice as many Not Preventable visits on average than their counterparts who speak English less than well. Similarly, the share of Not Preventable visits is greatest among those who speak English well (see Figure 15).

5.1.3 Social and Community Context

5.1.3.1 Age Category
(All ages at the time of ACS Interview; individual-level variable)

Health and health behaviors are known to vary across the life course (Warren, 2009; Villanueva et al., 2013). ED visits seem to vary by age in the same fashion. We examine a range of measures of social and community determinants of ED visits, including **age** categories (under 19, 19-26, 27-54, 55-64, 65 and older).

As expected, older age groups have the highest ED visit rates. Individuals aged 65 years and older made 1,760 visits per 1,000 people in comparison to the 1,312 visits per 1,000 people made by those under 19 years old.

Older individuals have more Preventable Emergency Care visits than those who are younger (see Figure 16). Individuals who were 65 years and older made twice as many Non-emergent, Primary Care Treatable, and Preventable visits as those who are under 19 years old (Median Age in Utah = 32.9 years). The average number of Not Preventable visits was more than four times greater among those 65 years and older than their youngest counterparts. Individuals who were 65 years and older accounted for double the share of Not Preventable visits when compared to those under 19 years (see Figure 17).

5.1.3.2 Internet Access
(All ages at the time of ACS Interview; household-level variable)

We include an indicator of whether a person has **internet access**, as it affects social engagement as well as health outcomes (Perzynski et al., 2017). Past research has also suggested that online health information influenced individuals' decisions to go the ED (Pourmand & Sikka, 2011). Based on past research, we expect internet access to be associated with ED utilization.

Looking at all ED visits, lack of internet access is associated with higher average ED utilization. On average, the ED visit rate for individuals without internet access was 40.0% higher than for individuals in households with internet access (2,070 visits vs. 1,479 visits per 1,000 population).

Similarly, individuals without internet access have more Preventable Emergency Care visits than those with internet access (see Figure 18). But, given that most people have access to internet, the share of Not Preventable visits was highest among individuals who have internet access (Percent of Households without internet access in Utah = 7.2%) (see Figure 19).

5.1.3.3 Marital Status
(Aged 15 or older at the time of ACS Interview; individual-level variable)

Marital status and family structure are also associated with a person's health and healthcare utilization (e.g, Chen & Escarce, 2006; Tumin, 2018). We examine type of ED visit by marital status (for people aged 15 and older) and find similar relationships between marital status and ED utilization.

Looking at all ED visits, individuals who are divorced, separated, or widowed are more likely to visit the ED than either married or never-married individuals. Those who were divorced, separated, or widowed made the most visits (2,144 visits), followed by those that were never married (1,552 visits), and those

that are married (1,477 visits) per 1,000 people. These results are qualitatively in line with those from Sun et al. (2003).

Individuals who are divorced, separated, or widowed also have more Preventable Emergency Care visits than those who are married or never married (see Figure 20). On average, those in this marital status category made about twice the number of Non-emergent, Primary Care Treatable, and Preventable visits than their counterparts (Percent Married in Utah = 55.6%). In contrast, those who were married have the largest percentage of Not Preventable visits (see Figure 21).

5.1.3.4 Nativity
(All ages at the time of ACS Interview; individual-level variable)

Nativity (U.S. born, foreign born) is associated with barriers in access to healthcare, such as lack of health insurance (Reyes & Hardy, 2014; Siddiqi et al., 2009). Similar to past research, we find that foreign-born individuals used EDs less often than the U.S.-born population. As with the other SDOH, only PIKed ACS records and PIKed UDOH records that link together by PIK are used in our Section 5.1 analyses.

Looking at all ED visits, U.S.-born residents visit the ED more often than their foreign-born counterparts. U.S. natives made an average 1,541 visits per 1,000 population in comparison to the 1,307 visits per 1,000 population made by the foreign-born population. These findings are qualitatively in line with those from Tarraf et al. (2015).

U.S.-born residents have more Preventable Emergency Care visits than foreign-born persons (see Figure 22). Individuals born in the U.S. made higher average numbers of Non-emergent, Primary Care Treatable, and Preventable visits than their foreign-born counterparts (Percent Foreign-born Residents in Utah = 8.4%). Not Preventable visits were also greater on average for U.S.-born people. Foreign-born persons made about two-thirds of the Not Preventable visits made by U.S.-born individuals. However, the share of Not Preventable visits is not substantively different across groups (see Figure 23).

5.1.3.5 Race and Hispanic Origin
(All ages at the time of ACS Interview; individual-level variable)

We group **race and Hispanic origin** into the following mutually exclusive categories: non-Hispanic White, non-Hispanic Black, non-Hispanic other race, and Hispanic (regardless of race).

Like past research on race, Hispanic origin, healthcare experiences, and non-emergent ED visits (Institute of Medicine, 2004; Jiang, et al., 2014; Li, et al., 2003), the frequency of ED visits varies by race/ethnicity. Non-Hispanic (NH) Black individuals made more ED visits than others. This is qualitatively in line with Roberts et al. (2008), which found Black individuals to have a higher ED visit rate than White individuals at the beginning of the study period. Specifically, NH Black individuals have the highest ED visit rate (1,828 visits per 1,000 population), followed by Hispanic (1,592 visits per 1,000 population), NH White (1,511 visits per 1,000 population), and NH other race (1,423 visits per 1,000 population) individuals. The higher frequency of visits among NH Blacks is consistent with research on neighborhood composition, in which a higher concentration of NH Blacks was associated with greater ED visit rates (Li, et al., 2003).

NH Black persons have more Preventable Emergency Care visits than all other race/ethnic groups (see Figure 24). On average, NH Black individuals had higher average numbers of most types of visits than

other groups (Percent of NH Whites in Utah = 79.1%). This finding supports past research, in which NH Blacks made more non-emergent visits than did other race and ethnicity groups (Jiang, et al., 2014). In particular, NH Black persons made about twice as many Non-emergent visits as NH other race persons. NH White individuals had the largest percentage of Not Preventable visits (see Figure 25).

5.1.3.6 Sex
(All ages at the time of ACS Interview; individual-level variable)

Consistent with past research on sex, health, health behaviors and non-emergent visits (Case & Paxson, 2006; Jiang, et al., 2014; John and Wu, 2019), sex differences are also apparent for ED utilization. Looking at all ED visits, women made more ED visits than men during the 2013-2017 period (1,632 visits per 1,000 population in comparison to 1,410 visits per 1,000 population for men).

Women also have more Preventable Emergency Care visits than men (see Figure 26). On average, women made nearly twice as many Non-emergent visits (per 1,000 population) than men. This finding echoes past research, in which women made more non-emergent visits than did men (Jiang, et al., 2014). However, the number of Not Preventable visits was not substantively different (Percent of Women in Utah = 49.7%). In contrast, men accounted for a larger share of Not Preventable Visits than women (see Figure 27).

5.1.3.7 Current Military or Past (Veterans)
(Aged 18 or older at the time of ACS Interview; individual-level variable)

Past or current military service entitles service members and their families to health coverage through TRICARE (current duty) or VA health benefits (veterans) (TRICARE, 2020; Department of Veterans Affairs, 2020). Military service is also associated with a higher prevalence of injuries, substance abuse, and mental health disorders (Olenick et al., 2015). Therefore, we examine **current military experience or past (veterans) status** (i.e., military background vs. non-military background) by ED visits and find that those with and without a military background use EDs at similar rates.

Individuals with and without military experience make an equivalent number of Preventable Emergency Care visits (see Figure 28). However, those with military experience had a larger percentage of Not Preventable visits by average and percentage compared to their counterpart (Percent of Current Military or Past [Veterans] in Utah = 6.1%). Specifically, individuals with military experience made about 1.4 times as many Not Preventable visits as individuals with no military experience on average. Veterans made about 1.3 times the share of Not Preventable visits as their non-veteran counterparts (see Figure 29).

5.1.3.8 Years
(All ages at the time of ACS Interview; individual-level variable)

We also include a cross-tabulation by **year** to assess whether there are any differences in ED visits across ACS data years. Looking at all ED visits, the average visit rate is higher in 2013 than 2017, but most between-year comparisons are not significantly different. There were 1,557 visits in 2013 and 1,476 visits in 2017 per 1,000 population. All data years had numbers of Preventable Emergency Care visits per 1,000 population that were not substantively different (see Figure 30). The occurrence of Not Preventable visits across years by average visit rate and percentage was also equivalent (see Figure 31).

5.1.4 Health and Healthcare

5.1.4.1 Disability Status
(Aged 15 or older at the time of ACS Interview; individual-level variable)

The ACS contains information about a person's limitations or **disabilities** across six domains, namely whether they have hearing, vision, cognitive, ambulatory, self-care, or independent-living difficulties (U.S. Census Bureau, 2020a). Consistent with prior research (e.g., Read et al., 2020), we create new variables for whether an individual has any of these six difficulties and the number of difficulties that they have. Importantly, children under age 5 only have information about the first two types of difficulties, and children under age 15 only have information about the first five. We limit our analyses to the population 15 years and older to capture all six difficulties[18].

Consistent with our expectations (for instance, given Lunsky et al. (2012)), the presence of any disability is related to higher ED use. Individuals with disabilities made about 2,588 visits, in comparison to the 1,457 visits made by those without a disability per 1,000 population.

Individuals with a disability have more Preventable Emergency Care visits than those without a disability (see Figure 32). On average, people who had any disability made more than twice as many Non-emergent, Primary Care Treatable, and Preventable visits than those without a disability (Percent with Any Disability in Utah = 12.3%). Not Preventable visits are also more frequent among those with any disability on average. Individuals with disabilities made twice as many Not Preventable visits as those without disabilities. In comparison, similar shares of those with and without disabilities made Not Preventable visits (see Figure 33).

5.1.4.2 Health Insurance Status
(All ages at the time of ACS Interview; individual-level variable)

The ACS measures **health insurance status** at the time of the interview (U.S. Census Bureau, 2020a). We recode six 'yes'/'no' items to indicate whether a person has any comprehensive health insurance[19]. The presence of health insurance is related to reduced numbers of Preventable Emergency Care visits and ED visits in general (Miller, 2012; Baker, et al., 2014; Gushu et al., 2019), which our findings support. Looking at all ED visits, a lack of health coverage is associated with higher ED use. Individuals without insurance made 1,692 visits per 1,000 population, in comparison to the 1,498 visits made by those with health insurance per 1,000 population. A related factor could be whether or not patients report having a usual source of care (Weber et al., 2005).

Individuals without health insurance have more Preventable Emergency Care visits than those with health insurance (see Figure 34). On average, most types of visits were more common among uninsured people, with the exception of Not Preventable visits (Percent Uninsured in Utah = 11.2%). In contrast, individuals with insurance had a larger percentage of Not Preventable visits than those without insurance (see Figure 35).

[18] Although the official ACS universe for disability status includes all age groups, our analyses of disability status are limited to the population 15 years and older.

[19] There are six types of health insurance: 1) Employer Based, 2) Direct Purchase, 3) TRICARE/Military Health Insurance, 4) Medicaid, 5) Medicare, and 6) VA Health Coverage. Indian Health Service is not included because it is not considered comprehensive.

5.1.4.3 Public Coverage
(All ages at the time of ACS Interview; individual-level variable)

We also include a measure of whether a person has **public health insurance coverage** (Medicare, Medicaid, or military coverage other than TRICARE), as opposed to private health insurance coverage (employer-sponsored, direct-purchase, or TRICARE). Research focusing on ED use (e.g., Tang et al., 2010; Taubman et al., 2014; Jiang, et al., 2014; Moulin, et al., 2018) finds Medicaid participation to be associated with general ED and non-emergent ED utilization. Policymakers may be interested in use by coverage type, as Medicaid, Medicare, and VA healthcare comprise a large share of federal and state funding (Snyder & Rudowitz, 2016). We note that the public and private categories are not mutually exclusive, so people can have both public and private insurance simultaneously. However, these estimates are based on having any type of public coverage.

Similar to past research, individuals with public health coverage have higher ED utilization than people with private coverage (Moulin, et al., 2018). Those with public coverage made more ED visits than those without public health coverage (2,111 visits vs. 1,360 visits per 1,000 population). They also have more Preventable Emergency Care visits than those without public coverage (see Figure 36). On average, those with public coverage made at least twice as many visits of all types as those without public coverage (Public Coverage Rate in Utah = 21.3%). The greater number of non-emergent visits among those with public coverage is consistent with past research, which found that individuals with public coverage (i.e., Medicaid) accounted for a larger number of these visits (Jiang, et al., 2014). Individuals with public coverage made about more than twice as many Not Preventable visits as individuals without public coverage (160 visits vs. 69.6 visits per 1,000 population). In contrast, individuals without public coverage had a slightly larger percentage of Not Preventable visits than those with public coverage (20.6 visits per 1,000 population vs. 18.6 visits per population) (see Figure 37).

5.1.5 Neighborhood and Built Environment

5.1.5.1 Vehicle Access
(All ages at the time of ACS Interview; household-level variable)

Transportation has also been identified as a social determinant of health (Artiga & Hinton, 2018) and a barrier to healthcare access (Peipins et al., 2013); therefore, we examine ED visit patterns by an indicator of whether or not individuals living in a household have **access to vehicle**.

We find that lack of access to a vehicle is associated with more ED visits. Individuals living in households without a vehicle made 2,507 visits per 1,000 population in comparison to the 1,497 visits per 1,000 population made by those living in households with a vehicle.

Individuals living in households without a vehicle have more Preventable Emergency Care visits than individuals living in households with a vehicle (see Figure 38). Those in households without a vehicle made about 1.7 times as many ED visits of all types as those living in households with a vehicle. This is qualitatively in line with findings from Ray et al. (2021). However, despite the small population without access to a vehicle (2.4%, see Table 1-6), the share of Not Preventable visits was substantively different between households with and without access to a vehicle (see Figure 39).

5.1.5.2 Housing Tenure
(All ages at the time of ACS Interview; household-level variable)

The ACS data contain a number of measures of individuals' neighborhood and built environments, including information about individuals' homes (U.S. Census Bureau, 2020a). We examine **housing tenure** (owner-occupied unit, renter-occupied unit)**.**

Consistent with expectations from previous research (Ray et al., 2021; Pollack et al., 2010; Li, et al., 2003), housing tenure is associated with ED visits. Individuals living in renter-occupied households have a higher ED visit rate than those in owner-occupied households. Individuals in renter-occupied households made 1,807 visits, whereas individuals in owner-occupied households made 1,409 visits per 1,000 people. This finding is consistent with past work, which found that neighborhoods with a higher concentration of owner-occupied units had lower ED visit rates (Li, et al., 2003).

Individuals living in renter-occupied households also make more Preventable Emergency Care visits than those living in owner-occupied households (see Figure 40). Those living in renter-occupied households made almost twice as many average visits of all types, with the exception of Not Preventable visits. Individuals living in owner-occupied households had a larger share of visits that are Not Preventable compared to those living in renter-occupied households (Home Ownership Rate in Utah = 71.9%, see Figure 41).

5.2 Examination by Linkage Year

Our main UDOH ED-ACS dataset contains UDOH ED visits linked with ACS interviews from any year over 2013-2017. As a robustness check, we also try constraining the UDOH-ACS linkage to only same-year ED visits and ACS interviews (e.g., 2013 ACS interview linked to 2013 ED visits). Our findings indicate that constraining the linked records as such produces very similar results to those presented above for any-year linkage, except with larger margins of error due to the associated smaller sample sizes. Most SDOH patterns from Section 5.1 for any-year linkage still hold here with same-year linkage. For example, consider the results by age group, as shown for same-year linkage, in Figures 42 and 43, versus the prior results for any-year linkage, in Figures 16 and 17. The rankings of the bar heights within each figure are fairly stable regardless of whether single-year or any-year linkage is used.

5.3 Examination by Age Category

We also examine ED visit patterns by age group. The average number of visits per 1,000 population and percentage of visits (across the four main ED categories) are calculated for the population under 19 years, 19-64 years, and 65 years and older.

For the '19-64 years' group, there are not many differences relative to the 'all ages' results that are presented above in Section 5.1. That is, in our linked data set, the 19-64 group is fairly representative of the broader all ages group with respect to social determinants of health.

For the population under 19 years old, a few SDOH are out of scope, for instance, educational status, employment status and marital status. And due to the age-restricted sample, some categories have larger margins of error, such that observed differences are no longer significant. Among the remaining SDOH, there are not many different patterns for children than for all ages. One exception, however, is the results by sex, as shown for people aged 0-18 in Figures 44 and 45, versus the Section 5.1 results for

all ages, as shown in Figures 26 and 27. Whereas, for people aged 0-18, the average number of ED visits across all types of visits is not substantively different between males and females, we saw in Section 5.1 that for people of all ages, females tend to have more Preventable Emergency Care visits than males. In addition, people aged 0-18 have lower shares of Not Preventable visits, when compared to men and women of all ages. Also, generally, people aged 0-18 have higher average numbers and/or shares of Primary Care Treatable visits and lower Not Preventable visits than people of all ages.

For the population 65 years and older, a few SDOH are naturally clustered for age-specific reasons, for instance, health insurance coverage (i.e., nearly all are enrolled in Medicare) and employment status (i.e., the majority retire and thus are not in the labor force). And due to the age-restricted sample, some categories have larger margins of error, such that observed differences are no longer significant. Among the remaining SDOH, there are not many different patterns for the population 65 years and older than for all ages. As an example of similar trends, consider Figures 46 and 47 relative to Figures 16 and 17 from Section 5.1. Just like for the broader all ages group, seniors aged 65 and over in households without internet access have more Preventable Emergency Care visits and a smaller share of Not Preventable visits than those in households with internet access.

5.4 Regression Models

The regression analyses described in this section build upon the descriptive analyses from Sections 5.1-5.3 by controlling for many factors simultaneously to determine whether the same SDOH continue to be predictive independent and net of one another. For instance, both higher household income and higher educational attainment are associated with reduced preventable ED visits, but they are also highly correlated with each other. The regression results should tell us if a net effect remains even after controlling for many other factors at once.

In Section 4.4 we developed three simple models that assess the likelihood of a preventable ED visit.

- Model 1 is at the visit-level and predicts the odds that an ED visit was preventable. The Model 1 analysis is analogous to the Sections 5.1-5.3 descriptive analysis (of the average numbers and shares of preventable ED visits for people with various characteristics), except with all of the characteristics controlled for at once.
- Model 2 is at the patient-level and predicts the odds that an ED patient had one or more preventable visits. The Model 2 analysis is similar to the Model 1 analysis, except that it studies people with ED visits instead of ED visits themselves.
- Finally, Model 3 is at the person-level and predicts the odds that a person had one or more preventable ED visits. The Model 3 analysis is analogous to the Section 3.7 analysis (of characteristics of people with one or more preventable ED visit relative to the characteristics of the overall Utah population), except with all of the characteristics controlled for at once.

As mentioned in Section 4.4, our goal is to affirm the existence of basic relationships between the SDOH and ED visits. As such, we have kept our models and description of results simple. We report only model diagnostics and statistical significance of the predictors, but not the estimated coefficients, in order to stay focused on the presence, not magnitude, of net effects.

We built each of our models in three ways: Stepwise regression, model fit, LASSO regression.[20] Below we discuss each approach and the related results in turn.

Stepwise Regression

First, we built a model using a stepwise regression. Under a stepwise regression approach, predictors are sequentially added if significant, and they subsequently may be dropped if their significance shrinks with the addition of new predictors. We applied a 95% significance level for either entering or staying in the regression. Regarding the order for introducing variables, we started with the predictors having the lowest raw correlations with the preventable ED visits and then worked our way up to the higher-correlating predictors last. In the end, we find that all of the SDOH listed in Table 1-8 (from Section 4.4) were justified for inclusion under these criteria.

Model Fit

Next, in order to test for the overall impact of the SDOH on the regression model fit, we studied changes in the Akaike Information Criterion (AIC). We started first with a baseline model of all SDOH variables included and then dropped each SDOH individually, but reverting back to the baseline model each time before dropping the next variable. We considered an AIC change greater than 1 to indicate the variable was an important predictor, and less than 1 to indicate the variable was a less important predictor Posada & Buckley, 2004).

Under this approach, we find the most important predictors of preventable ED visits, or of people who have a preventable ED visit, conditional on the other variables in the models, to include the following:

- Household income decile
- Educational status of high school diploma (or GED) or less
- Female
- Aged 65 and older
- Unemployed

And we find some less important predictors of Preventable ED visits, conditional on the other variables in the models, to include the following:

- Nativity
- English language ability
- Internet access
- Vehicle access
- Poverty status

LASSO Regression

Finally, we ran a LASSO regression, which is based on a self-updating or machine-learning concept. We do this in order to select predictors while reducing the probability that we overfit the model; also, LASSO regressions tend to be more stringent about finding significant predictors than are stepwise regressions.

[20] The 'LASSO' in LASSO regression stands for Least Absolute Shrinkage and Selection Operator.

Specifically, our LASSO regressions suggest the following SDOH are less important, conditional on the other variables included in the models, for predicting Preventable ED visits:

- English language ability
- Vehicle access
- Poverty status
- County-level uninsured rate
- County-level unemployment rate

Overall Results/Findings

All three of our models fit the data significantly better than an empty model, $p<.0001$. All variables significantly predict the likelihood of a Preventable ED visit occurring ($p<.05$ or smaller), with the exception of nativity status in Model 1 and SAIPE county-level poverty in Model 2. Although all three approaches appear to fit the data fairly well, the best fitting model (which had the smallest AIC and smallest Schwartz Criterion) is Model 2, which is at the patient-level, and assesses the likelihood of 1 or more Preventable ED visits.

As mentioned above, for several SDOH variables, we find strong relationships, with a high degree of consistency across the three models. Specifically, in all three approaches, the odds of visiting a Utah ED for a preventable reason are estimated to be greater for people with the following characteristics:

- Household income in the lowest two income deciles
- Aged 65 or older
- Female
- Receiving SNAP
- With any disability
- Belong to racial/ethnic minority (i.e., those who are not NH White)
- Divorced, separated, or widowed
- With public health insurance coverage
- With lower educational attainment
- Living in a renter-occupied unit

The four county-level factors (poverty rate, uninsured rate, percent Non-Hispanic White, and unemployment rate) were each estimated to be statistically significant and important in each of the regressions. In our visits model (Model 1), we also tested the inclusion of indicators for the month of the year (January through December) and day of the week (Sunday through Saturday) for the ED visit. While these measures were statistically significant, their inclusion did not materially change the relationships among the other variables.

Overall, the regression results from this section show agreement with the findings from the descriptive analyses in terms of which factors seem to matter the most for predicting preventable ED visits. Specifically, the results from Models 1 and 2 overlap heavily with those from Sections 5.1-5.3, and the results from Model 3 overlap heavily with those from Table 1-6 of Section 3.7. In other words, within the context of our linked UDOH ED-ACS file, for many SDOH, the presence of statistically significant bivariate (gross) effects appears to be a fairly reliable guide for the presence of related statistically significant predictors with multivariate (net) effects in our models.

Methodological Notes and Future Ideas

Given the ACS person and household characteristics are measured by a survey, they naturally contain sampling error, such as the representativeness of the survey, and non-sampling error, such as respondent interpretation of the questions (U.S. Census Bureau, 2014). For example, measurement error associated with reporting participation in social programs, such as SNAP and public health insurance coverage, could be an important consideration (Nguimkeu et al., 2019). Such measurement error would likely downwardly bias our coefficient estimates and thus make our conclusions conservative and possibly understated.[21]

We also separately examined interactions among the many SDOH variables, but when doing so we were limited regarding how many categorical variables we could include at once; we leave open the possibility of systematically testing for and accounting for interactions in future work as needed.

A further refinement to this modeling could be to control for the extent of health providers near to the Utah ED patients. For example, one might include predictors for proximity of the person (using ACS-based address or ZIP code location) to hospitals and to urgent care centers, or simply include a variable regarding the density of health providers within the county in which the ACS respondent resides. Another refinement could be to consider the specific timing of the ED visits relative to the ACS interviews. For instance, individual poverty status could be either/both the cause and/or the effect of an ED visit. A related refinement could be to leverage the panel nature of the UDOH ED visits file to estimate and account for any serial correlation in the preventability of ED visits for individuals over time.

6 Discussion

For Aim 1 of this work, we evaluated how SDOH are associated with preventable ED utilization in Utah during the 2013-2017 period. We assessed patterns in UDOH ED utilization across 19 social determinants by providing descriptive statistics (Sections 5.1-5.3) and estimating logistic regressions (Section 5.4). We find many SDOH that are clearly associated with ED visits, consistent with prior literature. In summary, these social determinants include the following:

- Household income decile
- Employment status
- Educational attainment
- Disability status
- Marital status
- Sex
- Housing tenure
- Internet access

Below we further discuss these main findings and their relationship to preventable ED utilization.

Individuals in households with higher income deciles make the fewest ED visits. Like with educational attainment, individuals in lower income deciles made more visits of all types than those in higher deciles. The share of Not Preventable visits declines in the opposite pattern; households in the highest

[21] Running the models with measurement error while incorrectly assuming fixed predictors will generally bias the estimated beta coefficients downwards to some degree, i.e., as attenuation bias (Hausman, 2001). This generally happens because the error term ends up absorbing the measurement error in the predictors, creating endogeneity.

deciles comprised a larger share of these visits than their counterparts. Households in higher income deciles are significantly less likely to make a preventable ED visit than households in lower deciles.

Individuals who are unemployed make more ED visits than those who are employed, not in the labor force or in the armed forces. Similarly, those who are unemployed also make more Preventable Emergency Care visits than their counterparts. On average, individuals that are unemployed make more ED visits of all types when compared to their employed counterpart. However, those who are employed have a higher percentage of Not Preventable visits.

We observe an educational gradient in ED visits. Individuals with lower educational attainment use EDs more often than those with more attainment. On average, those with lower educational attainment made more visits of all types than their counterparts (i.e., Preventable Emergency Care and Not Preventable visits). The trend reverses for the percentage of Not Preventable visits; those with the most education comprised the largest share of Not Preventable visits. Less educated groups are significantly more likely to make a preventable ED visit than those with a Bachelor's degree or greater.

Individuals with any disability make more ED visits than their counterparts without a disability. On average, those with any disability made more visits of all types than those without a disability. By percentage, those without a disability accounted for a larger share of Not Preventable visits.

Individuals who are divorced, separated, or widowed use EDs more than those who are married or have never been married. Those who were divorced, separated, or widowed made the most Preventable Emergency Care visits on average. However, individuals who were married have the largest share of Not Preventable visits. Similarly, individuals who are divorced, separated, or widowed are significantly more likely to make a preventable ED visit than those are married or never married.

Women make more ED visits than men. In particular, women made more Preventable Emergency Care visits than men. On average, there were no sex differences in Not Preventable visits. However, men accounted for a larger percentage of Not Preventable visits than women.

Individuals living in renter-occupied households visit EDs more than those living in owner-occupied houses. Those living in renter-occupied households made more Preventable Emergency Care visits than their counterpart. On average, individuals living in renter-occupied houses also made more visits of all types (excluding Not Preventable visits) than those living in owner-occupied households. However, those living in owner-occupied houses had a larger share of Not Preventable visits than their counterpart.

Individuals living in households without internet access make more ED visits than those living in households with internet access. Those living in households without internet access made more Preventable Emergency Care visits than their counterpart. In contrast, the share of Not Preventable visits was greater among those in households with internet access.

7 Conclusions

The Census Bureau's joint statistical project with UDOH enabled the creation of a valuable file of linked ACS data and UDOH ED encounters data, allowing our team to examine SDOH and ED visits in depth.

Using this unique linked file, as presented in our figures and regression analysis, we estimate strong relationships among the SDOH and UDOH ED visits for the four categories (Non-emergent, Primary Care Treatable, Preventable, and Not Preventable). In particular, people in Utah with lesser means (e.g., lower income, uninsured, lacking access to a vehicle, in renter-occupied housing) tend to use the Utah EDs more heavily for preventable reasons than do others. There are also major effects by household income decile (more preventable visits by those in lower deciles), sex (more preventable visits by females), educational status (more preventable visits by those with less schooling), and by disability status (more preventable visits by those with one or more disabilities). In addition, we estimate fewer preventable visits by those who are foreign born, and by those with less proficiency in speaking English.

Overall, the linked UDOH ED-ACS file enabled by this partnership agreement has shown significant value, allowing us to study the socioeconomic and demographic characteristics of people visiting EDs (by type of ED visit) in Utah in a cost-effective manner, and helping us to validate the measurement of many topics in the Census Bureau's ACS. Without the approved file linkages from this joint project, there are no ready substitutes for achieving findings of similar precision and confidence for both UDOH and the Census Bureau.

The Aim 1 analysis has a few advantages worth noting, including its use of theoretical framework and linkage system, its comprehensiveness across SDOH, and its contribution to ED research. First, the SDOH framework we used is a well-supported and conceptualized model of health and healthcare outcomes, which grounds our decisions about identifying predictors, drawing conclusions, and fitting optimal models (WHO, 2020). Second, the Census Bureau's PVS System for assigning unique identifiers is an established method with known strengths and weaknesses for our subsequent linkage (Wagner & Layne, 2014). Researchers can identify and account for any linkage shortcomings, which boosts our confidence about the match rate, accuracy, and findings. Third, this research provides a study of many different SDOH at once, using a common methodology, which facilitates finding which factors may be most important. Fourth, this work provides updated measures of the SDOH effects in general, and it extends the SDOH framework to ED use and the Utah context.

The results of Aim 1 suggests that future studies should continue to use linked survey-medical datasets as a method to answer novel research questions about SDOH. One pathway is to link the UDOH dataset with other sociodemographic surveys to further validate our estimated effects. Another research direction is to assess how preventable ED use varies with respect to a yet broader group of determinants within a single SDOH domain. We are also considering deeper analyses to identify the largest interaction effects across multiple SDOH at once, and we are considering panel data analyses to learn about within-person effects across time. Another opportunity is to use a different model to categorize ED visits or to use an expanded model which incorporates the five supplemental ED visit categories (i.e., Mental-Health, Alcohol, Substance-Abuse, Injury, and Unclassified) (Billings et al., 2000b). Finally, many other UDOH-relevant topics bear further study, including hospitalization rates, proximity of patients to ED facilities, and profiles of high-cost high-utilizer patients vs. low-cost low-utilizer patients.

Aim 2: Evaluate the utility of ED encounter data for use with Census Bureau survey collections

8 General Background for This Research

The Census Bureau has long supported the National Hospital Ambulatory Medical Care Survey (NHAMCS) data collection process, deploying Field Representatives (FRs) to the sampled survey sites to conduct survey interviews about hospital characteristics and manually abstract the needed survey health data directly from patient medical records. Physicians and hospitals have voiced concerns regarding the burden of reporting this information for the survey, stating they already provide similar information to a myriad of outside entities. Providers have stated that new methods of data collection must be explored for this survey.

The purpose of the research in Aim 2 is to explore whether UDOH ED visit data could be used to reduce the amount of NHAMCS data FRs presently collect for Utah hospitals, thereby reducing the burden to Utah providers who participate in the survey. This new method of data collection could considerably decrease the average total case time which is currently around 75-hours for hospitals. In addition, data quality may be enhanced if this method allows for new levels of detail about a patient visit, diagnosis, or care provided. We hope to demonstrate how existing electronic records might be used in the future to reduce respondent burden. In addition, we know that data users have a strong interest in sub-national NHAMCS PUF estimates. Therefore, we are exploring the feasibility of providing estimates on emergency department utilization for Utah. We hope to demonstrate Utah as a use-case for other states to see the utility of providing electronic health record data.

9 The NHAMCS Process

"The National Hospital Ambulatory Medical Care Survey (NHAMCS) is designed to collect data on the utilization and provision of ambulatory care services in hospital emergency and outpatient departments and ambulatory surgery locations. Findings are based on a national sample of visits to the emergency departments, outpatient departments, and ambulatory surgery locations of noninstitutional general and short-stay hospitals" (https://www.cdc.gov/nchs/ahcd/index.htm). In 2018, the survey began focusing on ambulatory care visits made to hospital emergency departments (EDs) only. The Census Bureau currently serves as the data collection agent for the NHAMCS, as well as the National Ambulatory Medical Care Survey (NAMCS), on behalf of the National Center for Health Statistics (NCHS). Together, NHAMCS and NAMCS provide a more complete picture of ambulatory medical care in the United States.

A multi-staged probability sampling process is utilized to ensure representative sampling across the United States. The first stage samples geographic areas known as Primary Sampling Units (PSUs). The second stage samples hospitals within the PSUs and assigns them to a 4-week reporting period.

Hospital ED information is collected during a survey induction interview. The patient and care relevant data are collected from a systematized random sampling of ED visits made during the assigned 4-week sampling period. These data are collected by trained Census Bureau FRs accessing medical records and using a computerized questionnaire. The data collected include patient demographic information and

visit characteristics such as diagnoses, patient's reason for visit, services ordered or provided, medications, and treatments.

NHAMCS data users include health care facilities, universities, and government agencies. Annual summaries from the survey were published in the Advance Data from Vital and Health Statistics series before 2006. In 2006 and 2007, these summaries were published in the National Health Statistics Report series. Since then, highlights of the data are published in Data Briefs. The standard summary tables, called public use files (PUFs), from the traditional publication series continue to be produced in PDF format available on the web (see https://www.cdc.gov/nchs/ahcd/ahcd_products.htm). Additional NHAMCS variables not included on the PUFs are available to authorized users in NCHS's Research Data Center. Primarily these variables are related to the sample design, detailed hospital characteristics, detailed visit characteristics, and geography (see https://www.cdc.gov/nchs/data/ahcd/Availability_of_NAMCS_and_NHAMCS_Restricted_Data.pdf).

The Ambulatory and Hospital Care Statistics Branch (AHCSB) at NCHS also compiles a series of Factsheets summarizing the national-level results of the hospital emergency departments sampled in NHAMCS. The Factsheets include data on items such as percent distribution of visits by age, annual visit rate by sex and race, top ten principal reasons for visits, etc. For a list of publications that use NAMCS and NHAMCS, see https://www.cdc.gov/nchs/data/ahcd/namcs_nhamcs_publication_list.pdf.

10 The Census-UDOH Process

All licensed hospitals and ambulatory surgical centers in Utah are required to provide data to the Office of Health Care Statistics (OHCS), part of the UDOH (Utah Department of Health, 2017). The providers collect the data and submit them to the OHCS on a quarterly basis. The UDOH collects a wide range of information on ED visits, including basic demographic information about the patient, information about the payer, reasons for the ED visit, diagnosis codes using the International Classification of Disease (ICD) codes, and the cost of the visit.[22] In 2019, the Census Bureau received a large dataset from UDOH including all ED visits reported state-wide. The data were provided in accordance with the JSP project agreement as part of the Census Bureau EHealth research project. The received data were formatted in a "claim-plus" format: it predominantly contains billing data in the X12 849 format, plus some additional data items. These data include all ED visits from 49 hospitals in Utah during that timeframe.

- The data elements from the 2017 UDOH dataset were cross-mapped with the data elements included in the 2017 NHAMCS PUFs. Sufficient matching was found and we proceeded with the recreation of the 2017 PUFs using UDOH data (available at https://www.cdc.gov/nchs/data/nhamcs/web_tables/2017_ed_web_tables-508.pdf). These results were then compared to the original NHAMCS results with the following questions in mind:

- What is the amount of processing required of the ED dataset so that it is in a format conducive to NHAMCS processing?
- What are the data elements collected by NHAMCS that are not included in the ED dataset?

[22] A codebook is here: https://gitlab.com/UtahOHCS/HFD_DUM/blob/master/Utah_HFD_Data_User_Manual.md

- How comparable are the data fields collected by both data sources to each other? Are they capturing the same information?
- How feasible is it to utilize the ED dataset to supplement or replace NHAMCS data collection?

11 This Project

11.1 Considerations

Differences in scope and scale of the NHAMCS and UDOH datasets are major, originating in the data acquisition process. Notably, the NHAMCS data includes only a random sampling of the medical records within the assigned 4-week period from EDs at sampled facilities within sampled PSUs. The UDOH data includes all ED visits at all facilities in the state at any point in 2017.

All of the NHAMCS and the UDOH data stem from patient medical records from emergency departments. In the case of NHAMCS, a trained interviewer (Census Bureau FR) reads the sampled medical records and completes a patient record form for each sampled record. The survey data are found in many different parts of the medical record, and a degree of interpretation and discernment (i.e., human judgement) is required to properly complete the survey.

In the case of the UDOH process, the original medical record data is processed to produce the billing claim. The standard format for billing data dictates certain inclusion, exclusion, and sequencing criteria. Logic included in this processing includes a standardized interpretation and determinations of relevance. UDOH receives this claim formatted data plus a few additional variables that the UDOH requires of the facilities in the state. Once shared with the Census Bureau, we determined the matching of the UDOH data elements to those included in the NHAMCS PUF.

11.2 Data Preparation

Minimal processing of the data is performed in order to retain as many records as possible. This allows us to make the appropriate comparison of visits in the UDOH data to visits in NHAMCS data. The dataset received from UDOH includes claims from 2013-2017. The data are separated by year of visit according to claim statement beginning date. This research aim focuses on 2017.

Of the 27 PUF tables published by NCHS, 15 are able to be produced from the UDOH data and 12 could not be created. For example, tables that include geographic region are not calculated because all hospitals in the UDOH data are from Utah, and, therefore, the same region. Similarly, the UDOH data does not contain information on hospital characteristics to determine ownership, teaching hospital indicator, and trauma center indicator. In the future it might be possible for UDOH to provide this information or the Census Bureau can get this information from other sources. The 27 tables and their replicability are described in Figure 48 below. Of the 15 tables that could be produced, 4 match exactly between using UDOH and NHAMCS data, 3 have more detail using UDOH data, 5 have more detail using NHAMCS data, and 3 others could relatively easily be adjusted to match in the future (i.e., 2 would match exactly if hospital ownership were obtained for the UDOH data and a third differs only by a category that UDOH combines and NHAMCS splits out, yet does not have enough sample size to disclose).

The tables presented in this paper are numbered based on the analogous NHAMCS PUF tables, but include a prefix of '2-' indicating that the tables are part of Aim 2 of this research paper. For example, Table 2-1 in this paper is analogous to the NHAMCS PUF Table 1. Specific detailed preparation is applied to the data when preparing the individual PUF table replicates. For all tables that include patient age, patient age is calculated by assessing the difference between patient birth year and the admission date of the visit. The admission dates are parsed into individual month, day, and year elements. Patient age is set to missing if birth-year or admission-year are less than 1897 or greater than 2017.

In every table, the number of visits is rounded according to the Census Bureau's Disclosure Review Board rounding guidelines. All column percentages and number of visits per 100 persons per year are based on these rounded number of visits.

Sequential data processes for replicating NHAMCS tables

For Table 2-1, "Emergency department visits, by selected characteristics", we:

1) Look up the hospital ED addresses and identify the county in which each is located;
2) Determine Metropolitan Statistical Area (MSA)/Non-Metropolitan Statistical Area status for each county and apply MSA and non-MSA categorization; and
3) Calculate the frequency and percent distribution of visits in MSA and Non-MSA locations, for aggregations of MSA status (not for individual MSAs).
    - See Delineation Files, available at https://www.census.gov/geographies/reference-files/time-series/demo/metro-micro/delineation-files.html.
    - See map of Utah Core Based Statistical Areas (CBSA) and counties, available at https://www2.census.gov/geo/maps/metroarea/stcbsa_pg/Feb2013/cbsa2013_UT.pdf.

For Table 2-2, "Emergency department visits, by patient age and sex, and residence", we:

1) Create age group categories based on the new patient age variable;
2) Calculate frequency and percent distribution of visits by age and sex;
3) Calculate number of visits per 100 persons per year using the 2017 American Community Survey (ACS) 1-year estimates for Utah (data.census.gov) including:
    a. Number of visits in group/population of group in Utah x 100, and
    b. All children under 5 years old, since children under 1 year old are not available on data.census.gov. Please note, residence information is not calculated because it is not available in the dataset.

Urban-rural classification (large central metro, large fringe metro, medium metro, small metro, micropolitan, and noncore) is made using hospital ED ZIP code, and we present the aggregate number of visits from the UDOH data by urban-rural classification consistent with the classification in the public NHAMCS tables.

When building Table 2-3, "Emergency department visits by patient race, age, and ethnicity", we:

1) Consolidate race categories into White, Black or African American, and Other;

a. If patient-race is in ‘3’ or ‘2106-3’ (an older category) set it to ‘3’ (White);

b. If patient-race is in ‘1’, ‘2’, ‘2131-1’, or ‘7’ set it to ‘5’ (Other);

2) Calculate frequency and percent distribution of visits by race and age;

a. Calculate number of visits per 100 persons per year using the 2017 ACS 1-year estimates for Utah from data.census.gov;

b. Re-categorize ethnicity to Hispanic or Latino, not Hispanic or Latino, and race subcategories of not Hispanic or Latino by combining ethnicity and race variables;

3) Calculate frequency and percent distribution of visits by ethnicity; and

4) Calculate number of visits per 100 persons per year for ethnicity using the 2017 ACS 1-year estimates for Utah from data.census.gov using the same calculation as in Table 2-2 for each group.

For Table 2-6, “Expected source of payment at emergency department visits”, we:

1) Consolidate payment categories and only include private insurance, Medicaid or CHIP, Medicare, no insurance, other, and unknown or blank; and

2) Calculate frequency of visits by payment source.

For Table 2-10, “Ten principal reasons for emergency department visits, by patient age and sex”, we:

1) Identify the top ten reasons for visit by calculating frequency of patient_reason_for_visit_1 in all records using proc summary;

2) Calculate frequency and percent distribution for those reasons;

3) Identify the top ten reasons for visit by calculating frequency of patient_reason_for_visit_1 by age and patient sex using proc summary nway;

4) Assign ranks to the frequency dataset to label the top ten reasons; and

5) Calculate frequency and percent distribution for each reason by group.

When creating Table 2-11, “Primary diagnosis at emergency department visits, by major disease category”, we:

1) Parse out the principal-diagnosis-code by letter and first two numbers and assign diagnosis groups based on values of principal-diag-letter and principal-diag-number (these diagnosis groups corresponded to the major disease category groups);

2) Calculate frequency and percent distribution by major disease category.

For Table 2-12, “Annual number and percent distribution of emergency department visits, by diagnosis group”, we:

1) Parse out the principal-diagnosis-code by letter and first two numbers and assigned diagnosis groups based on the values of principal-diag-letter and principal-diag-number;

2) Format the principal diagnosis code based on the Diagnosis Master Category List (see https://www.cdc.gov/nchs/data/ahcd/Reclass_ICD_10_CM_tables.pdf); and

3) Calculated frequency and percent distribution of principal diagnoses.

For Table 2-13, "Presence of chronic conditions at emergency department visits", we:

1) Collapse diagnosis codes into chronic conditions; and

2) Calculate frequency and percent distribution by chronic condition.

For Table 2-14, "Injury visits to emergency departments, by selected patient characteristics", we:

1) Include records where primary diagnosis code was in the 'Injury, poisoning, and certain other consequences of external causes' group;

    a. Records are excluded when patient sex = 'U' (Unknown);

2) Divide age into age groups;

3) Calculate frequency and percent distribution by sex and age groups;

4) Calculate number of visits per 100 persons per year using the 2017 ACS 1-year estimates for Utah from data.census.gov; and

5) Using the same MSA/Non-MSA statuses from Table 2-1, we then:

    a. Calculate frequency and percent distribution of injury visits by MSA status;

    b. Calculate number of visits per 100 persons per year using the 2017 county population totals from the 2010 Census results (see https://www.census.gov/data/tables/time-series/demo/popest/2010s-counties-total.html) and calculating as the number of injury visits in MSA or non-MSA area/total population in MSA or non-MSA areas X 100.

Injury visits by hospital ownership are not calculated because hospital ownership data is not available. Injury visits by geographic region are not relevant because all visits are in Utah.

When creating Table 2-15, "Injury visits to emergency departments, by race, age, and ethnicity", we:

1) Include records where primary diagnosis code was in the 'Injury, poisoning, and certain other consequences of external causes' group;

2) Use the same race, age, and ethnicity categories as in Table 2-3;

3) Calculate frequency and percent distribution of injury visits by race and age;

4) Calculate frequency and percent distribution of injury visits by ethnicity; and

5) Calculate number of visits per 100 persons per year using the 2017 ACS 1-year estimates for Utah from data.census.gov as number of visits in group/population of group in Utah x 100.

For Table 2-16, "Emergency department visits related to injury, poisoning, and adverse effect, by intent", we:

1) Include records where primary diagnosis code was in the 'Injury, poisoning, and certain other consequences of external causes' group;

2) Merge UDOH e_code_1 with the 'Detailed ICD-10 Code Listing For All Injury Diagnosis Codes' from a list of injury codes, intent, and mechanisms (available at https://www.cdc.gov/nchs/injury/injury_matrices.htm); and

3) Calculate frequency and percent distribution of intent of injury visits.

When building Table 2-17, "Emergency department visits related to injury, poisoning, and adverse effect, by mechanism", we:

1) Use the same merged dataset from Table 2-16;

2) Combine the MVT subgroups into one group 'Motor vehicle – traffic';

3) Group 'Poisoning, Non-drug' and 'Bites and Stings, nonvenomous' into 'Other' group; and

4) Calculate frequency and percent distribution of mechanism of injury visits.

For Table 2-23, "Providers seen at emergency department visits", we:

1) Collapse five taxonomy variables into a single variable (patient may see several providers in same visit);

2) Use Health Care Provider Taxonomy Code Set (Version 17.1) to merge with Utah data to identify what positions/specialties the taxonomy code represented;

3) Group the taxonomy codes into similar categories as shown in the NCHS table; and

4) Calculate frequency and percent distribution of taxonomy codes.

When creating Table 2-24, "Disposition of emergency department visits", we:

1) Group dispositions into three categories: admitted, transferred, or died;

2) Identify which visits included instruction for Outpatient follow-up or where the patient left prior to completing visit;

3) Identify which answer categories fell into the appropriate categories in the NHAMCS table; and

4) Calculate frequency and percent distribution of dispositions.

For Table 2-25, "Emergency department visits resulting in hospital admission, by selected patient and visit characteristics", we:

1) Select only visits resulting in hospital admission;

2) Use the same age categories in previous tables;

3) Use the same source of payment categories consistent with the NHAMCS PUF Table 25;

4) Calculate frequency and percent distribution of visits resulting in hospital admission; and

5) Calculate number of visits per 100 persons per year using the 2017 ACS 1-year estimates for Utah from data.census.gov as number of visits in group/population of group in Utah x 100.

11.3 Results Assessment

Of the 27 PUFs published by NCHS, 15 can be produced from the UDOH data (see Data Preparation, above). They are discussed individually below. Some tables can be fully replicated including all variables and sub-categories as seen in the analogous PUF table. Some tables are mostly or partially replicable, meaning some variables and categories from the PUF table can be recreated, but others cannot because categories are not available in the UDOH dataset or there is a mismatch between UDOH data variable values and PUF table elements. For the tables that could not be replicated, the UDOH dataset did not provide the information needed to create the analogous PUF table or there were too many category mismatches to be able to create an analogous table. Below lists the NHAMCS PUF tables that can be at least partially replicated using the Utah data and the PUF tables that could not be replicated with the Utah data provided.

Figure 48. List of NHAMCS PUF tables by replicability

NHAMCS PUF tables that could at least be partially replicated using UDOH data (differences noted in parentheses, with possibilities for the future described)	NHAMCS PUF tables that could not be replicated using UDOH data (possibilities for the future described)
Table 2-1: "Emergency department visits, by selected characteristics" (UDOH data do not include hospital ownership, hospital characteristics on trauma centers or teaching hospitals, or geographic region of hospitals. Per UDOH, in a future delivery to the Census Bureau, it is technically feasible to add or impute these data from the actual hospital name/ID.)	Table 4: "Wait time at emergency department visits" (Per UDOH, they do not collect this information.)
Table 2-2: "Emergency department visits, by patient age, sex, and residence"	Table 5: "Mode of arrival at emergency department" (Per UDOH, they do not collect this information.)
Table 2-3: "Emergency department visits, by patient race, age, and ethnicity" (UDOH data had a MORE detailed table because the "other race" category could be broken out by broad age group)	Table 7: "Triage status of emergency department visits, by selected patient characteristics" (Per UDOH, they do not collect this information.)
Table 2-6: "Expected source of payment at emergency department visits" (UDOH data include worker's compensation in with the other category; NHAMCS splits them out. UDOH has a category for no insurance; NHAMCS splits out self-pay vs. no charge/charity. UDOH includes those who have both Medicare and Medicaid in with the Medicare number whereas NHAMCS includes them as a separate category. Per UDOH, in a future delivery, this could be adjusted. It	Table 8: "Initial blood pressure recorded at emergency department visits for adults" (Per UDOH, they do not collect this information.)

would require a discussion as to what is needed. If a researcher wanted to manually review the free-text payer strings, it might be possible to capture these additional subcategories. Newer data have hospital-assigned classification, which can also help.)	
Table 2-10: "Ten principal reasons for emergency department visits, by patient age and sex"	Table 9: "Initial temperature, pulse oximetry, and visit history" (Per UDOH, they do not collect this information.)
Table 2-11: "Primary diagnosis at emergency department visits, by major disease category"	Table 18: "Selected diagnostic and screening services ordered or provided" (Per UDOH, they do not collect this information.)
Table 2-12: "Annual number and percent distribution of emergency department visits, by diagnosis group" (UDOH data have many more sub-categories of diagnosis group and more often had a sample size large enough to disclose them as compared to NHAMCS.)	Table 19: "Selected procedures" (The necessary fields were provided by UDOH. To create the table, NCHS would need to provide a complete list of which ICD codes are included in each select procedure, so we could correctly recode the UDOH data.)
Table 2-13: "Presence of chronic conditions at emergency department visits" (UDOH data include 14 categories of chronic conditions; NHAMCS has 24. For some of the NHAMCS categories, UDOH data include them as well, but there were too few cases to be disclosed so they are included in 'Other'.)	Table 20: "Medication therapy and number of medications mentioned" (Per UDOH, they do not collect this information.)
Table 2-14: "Injury visits to emergency departments, by selected patient characteristics" (UDOH data do not include hospital ownership or region. Per UDOH, this is available, but was not included in the Census Bureau delivery.)	Table 21: "Twenty most frequently mentioned drugs at emergency department visits, by therapeutic drug" (Per UDOH, they do not collect this information.)
Table 2-15: "Injury visits to emergency departments, by race, age, and ethnicity" (UDOH had more detail because "other race" could be broken out by broad age group. Also note that UDOH had a category for unknown/blank ethnicity which is 27.8% of visits; NHAMCS did include a category for unknown/blank. Per UDOH, this is available, but was not included in the Census Bureau delivery.)	Table 22: "Twenty most frequently mentioned drugs at emergency department visits" (Per UDOH, they do not collect this information.)
Table 2-16: "Emergency department visits related to injury, poisoning, and adverse effect, by intent"	Table 26: "Principal hospital discharge diagnoses for patients admitted through emergency department" (This table includes all ED visits that resulted in a hospital admission. It excludes all ED visits

Table 2-17: “Emergency department visits related to injury, poisoning, and adverse effect, by mechanism” (UDOH does not have a “fire or burn” category; NHAMCS has a category for “fire or burn” and another for “fire or flame”, but without sufficient sample size to disclose the second category.)
Table 2-23: “Providers seen at emergency department visits” (UDOH data were blank on 57.9% of the records, NHAMCS reports on more types of providers seen and has only 0.2% blank.)
Table 2-24: “Disposition of emergency department visits” (UDOH records were coded as “routine” 95.1% of the time. NHAMCS has no category labelled as routine and many more categories included in the table.)
Table 2-25: “Emergency department visits resulting in hospital admission, by selected patient and visit characteristics” (Categories that are not included in the UDOH data but are included in the NHAMCS data are residence type, mode of arrival, triage category, was patient seen in the ED during last 72 hours, and hospital discharge status. Per UDOH, they do not collect these additional categories.)

that did NOT result in a hospital admission. Per UDOH, they do collect this information, only it is stored on the inpatient records.)
Table 27: “Hospital and emergency department characteristics” (Per UDOH, they do not collect most of this information directly. Potentially some attributes could be imputed from the hospital or ED name/ID.)

The data from the NHAMCS PUF tables are sample data weighted to produce national estimates. The NHAMCS results presented below include the estimates from the PUF tables. For standard errors associated with these estimates, see National Center for Health Statistics’ 2018 report, by Rui & Kang (https://www.cdc.gov/nchs/data/nhamcs/web_tables/2017_ed_web_tables-508.pdf). Unless otherwise noted, comparisons between UDOH counts and NHAMCS estimates were not statistically tested, and therefore differences are not indicated or implied.

The type of information presented in Table 2-1: “Emergency department visits, by selected characteristics” using the Utah data is mostly analogous to the type of information presented in NHAMCS PUF Table 1. Without hospital characteristics, some of the fields could not be created. The Utah Table 2-1 shows 736,000 visits took place during 2017, which is a rate of 23.7 per 100 persons per year. The NHAMCS Table 1 for 2017 has a rate of 43.3 per 100 persons per year. The Utah Table 2-1 shows 22.9 visits per 100 persons per year in metro areas and 30.5 visits per 100 persons per year in non-metro areas. The NHAMCS Table 1 shows 43.1 visits per 100 persons per year in metro areas and 45.3 visits per 100 persons per year in non-metro areas. The Utah Table 2-1 has a small seasonal range

in rate of visit (5.6 visits per 100 persons in the fall and 6.3 visits per 100 persons in the summer). The NHAMCS Table 1 ranges from 8.0 visits per 100 persons in the spring to 13.6 visits per 100 persons in the winter.

The type of information presented in Table 2-2: "Emergency department visits, by patient age, sex, and residence" using the Utah data is mostly analogous to the type of information presented in NHAMCS PUF Table 2. The Utah emergency department visits are 55.3% female and 44.7% male while the NHAMCS visits are 55.6% female and 44.4% male. The Utah data are 39.3% medium metro, 39.1% large central metro, and 10.1% micropolitan. The NHAMCS data are 25.6% large central metro, 25.0% medium metro, and 9.2% micropolitan.

The type of information presented in Table 2-3: "Emergency department visits, by patient race, age, and ethnicity" using the Utah data is a full recreation of the type of information presented in NHAMCS PUF Table 3. The Utah visits are 82.3% white, 2.4% black or African American, and 9.9% other. The NHAMCS visits are 70.1% white, 26.1% black or African American, and 3.8% other. The Utah visits are 9.2% Hispanic or Latino and the NHAMCS visits are 15.9% Hispanic or Latino.

The type of information presented in Table 2-6: "Expected source of payment at emergency department visits" using the Utah data is almost the same as the type of information in the NHAMCS PUF Table 6. The exception is that worker's compensation is included in the 'other' category for the Utah data. For Utah, 35.3% of visits are expected to be covered by private insurance, 23.8% of visits are expected to be covered by Medicaid or CHIP, 20.6% by Medicare, and 13.4% no insurance. For NHAMCS, 31.2% are expected to be covered by private insurance, 40.3% are expected to be covered by Medicaid or CHIP, 18.5% Medicare, and 8.0% no insurance.

The type of information presented in Table 2-10: "Ten principal reasons for emergency department visits, by patient age and sex" using the Utah data is a full recreation of the type of information presented in NHAMCS PUF Table 10. For Utah, the top ten reasons for visits are 1) unspecified abdominal pain, 2) unspecified chest pain, 3) headache, 4) cough, 5) unspecified fever, 6) shortness of breath, 7) low back pain, 8) unspecified injury of head, 9) unspecified dorsalgia, and 10) dizziness and giddiness. For NHAMCS, the top ten reasons for visits are 1) stomach and abdominal pain, cramps, and spasms, 2) chest pain and related symptoms, 3) fever, 4) cough, 5) shortness of breath, 6) unspecified pain, 7) headache, pain in head, 8) back symptoms, 9) vomiting, and 10) throat symptoms.

The type of information presented in Table 2-11: "Primary diagnosis at emergency department visits, by major disease category" using the Utah data is a full recreation of the type of information presented in NHAMCS PUF Table 11. For the Utah data, the top 5 diagnoses by percent distribution are 1) injury, poisoning and certain other consequences of external causes (24.2%), 2) symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (23.4%), 3) diseases of the respiratory system (8.6%), 4) diseases of the genitourinary system (6.5%), and 5) diseases of the musculoskeletal system and connective tissue (6.4%). For the NHAMCS data, the top 5 diagnoses by percent distribution are 1) symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (23.5%), 2) injury, poisoning and certain other consequences of external causes (18.9%), 3) diseases of the respiratory system (10.6%), 4) diseases of the musculoskeletal system and connective tissue (8.1%), and 5) diseases of the digestive system (5.9%).

The type of information presented in Table 2-12: "Annual number and percent distribution of emergency department visits, by diagnosis group" using the Utah data is a full recreation of the type of information presented in NHAMCS PUF Table 12. Many categories include enough visits that they can be disclosed in accordance with the Census Bureau's disclosure policy. There are quite a few categories on the NHAMCS tables that do not meet NCHS's standard of reliability.

The type of information presented in Table 2-13: "Presence of chronic conditions at emergency department visits" using the Utah data is very similar to the type of information presented in NHAMCS PUF Table 13. The difference is that the Utah data has fewer conditions available compared to the NHAMCS PUF table. The 'none of the above' category represents 97.3% of visits in the Utah data and 50.2% in the NHAMCS data.

The type of information presented in Table 2-14: "Injury visits to emergency departments, by selected patient characteristics" using the Utah data is very similar to the type of information presented in NHAMCS PUF Table 14. The difference is that the Utah data does not have information on ownership characteristics. The Utah data are 27.0% aged 25-44 and 24.2% under age 15. They are also 47.2% female and 52.8% male. The NHAMCS data are 27.4% aged 25-44 and 21.7% under age 15. They are 47.7% female and 52.3% male.

The type of information presented in Table 2-15: "Injury visits to emergency departments, by race, age, and ethnicity" using the Utah data is a full recreation of the type of information presented in NHAMCS PUF Table 15. The Utah data are 22.2% white aged 25-44, 0.6% black/African American aged 25-44, and 4.4% other aged 25-44. They are also 8.4% Hispanic or Latino of any age. The NHAMCS data are 19.2% white aged 25-44, 7.2% black or African American aged 25-44, and 3.8% other aged 25-44. They are also 14.1% Hispanic or Latino of any age.

The type of information presented in Table 2-16: "Emergency department visits related to injury, poisoning, and adverse effect, by intent" using the Utah data is a full recreation of the type of information presented in NHAMCS PUF Table 16. The Utah data are 75.8% unintentional and 14.9% blank. The NHAMCS data are 68.2% unintentional and 23.8% blank.

The type of information presented in Table 2-17: "Emergency department visits related to injury, poisoning, and adverse effect, by mechanism" using the Utah data is a full recreation of the type of information presented in NHAMCS PUF Table 17. The Utah data are 26.7% fall, 12.4% struck by or against, 12.1% all transportation, and 20.8% blank cause. The NHAMCS data are 24.3% fall, 12.3% struck by or against, 12.0% all transportation, and 23.8% blank cause.

The type of information presented in Table 2-23: "Providers seen at emergency department visits" using the Utah data is very similar to the type of information presented in NHAMCS PUF Table 23. However, many Utah records do not include information on providers seen (57.9%). For NHAMCS, only 0.2% records are blank.

The type of information presented in Table 2-24: "Disposition of emergency department visits" using the Utah data is only a partial reconstruction of the type of information presented in the NHAMCS PUF Table 24. The Utah data includes much less information in this regard than NHAMCS. In the Utah data, 95.1% are included in a category named 'routine'; this category is not included on the NHAMCS table.

The type of information presented in Table 2-25: "Emergency department visits resulting in hospital admission, by selected patient and visit characteristics" using the Utah data is very similar to age and expected source of payment presented in NHAMCS PUF Table 25. The Utah data are 26.8% aged 25-44 and 23.4% aged 45-64. The expected source of payment is 30.2% for private insurance and 27.8% for Medicare. The NHAMCS data are 27.2% aged 45-64 and 24.9% aged 75 and over. The expected source of payment is 43.5% Medicare and 36.9% private insurance.

NHAMCS Table entries that cannot be produced with Utah's ED data

For the 12 of the 27 NHAMCS PUF tables that cannot be produced from the UDOH data, the reasons they cannot be produced are described below.

Table 4: "Wait time at emergency department visits" is not produced as there are no time variables in the dataset.

Table 5: "Mode of arrival at emergency department" is not created as arrival mode is not included in the dataset.

Table 7: "Triage status of emergency department visits, by selected patient characteristics" is not produced as no triage information is included in the received dataset.

Tables 8 and 9: "Initial blood pressure recorded at emergency department visits for adults" and "Initial temperature, pulse oximetry, and visit history" also cannot be produced from the provided data. Blood pressure, temperature, and pulse oximetry are not included. There is no indication of episode of care (first visit or follow-up) in the dataset. Patient seen in ED within last 72 hours can only be roughly calculated based on admission date.

Table 18: "Selected diagnostic and screening services ordered or provided" and Table 19: "Selected procedures" are not produced for the following reasons: 1) procedures are ICD-10-PCS codes; 2) very few procedures are not blank; and 3) of those that are not blank, many do not correspond to the categories included in the tables. If NCHS were to provide their mapping logic, these tables may be possible to produce.

We cannot produce Table 20: "Medication therapy and number of medications mentioned", Table 21: "Twenty most frequently mentioned drugs at emergency department visits, by therapeutic drug", and Table 22: "Twenty most frequently mentioned drugs at emergency department visits", as no medication data are provided in the Utah dataset.

Table 26: "Principal hospital discharge diagnoses for patients admitted through emergency department" is not produced as the provided data included only ED visits. Hospital discharge information is not available.

Table 27: "Hospital and emergency department characteristics" is not produced. As noted above, no hospital ED characteristics are included in the provided data.

11.4 Discussion

11.4.1 The UDOH Data Versus NHAMCS PUF files

Approximately 15 of the 27 NHAMCS public use files (PUFs) can be partially or fully recreated from the UDOH ED data. Most of the 12 tables that could not be produced are because the UDOH dataset is missing key variables. The UDOH data are claims enhanced data and do not include some of the clinical data elements that are collected from hospital electronic health records used to produce the NHAMCS PUF tables. The dataset does not include information about hospital characteristics or the following information: residence address, mode of arrival, triage category, time variables, blood pressure, temperature, pulse oximetry, episode of care (first visit or follow-up), diagnostic and screening services and procedures, medication data. These additional components are necessary to replicate the NHAMCS PUF tables in full.

The UDOH ED and NHAMCS data are largely comparable for the remaining variables. The few exceptions are variables with reduced or different categories and majority blank records. Notable differences include: worker's compensation which need to be grouped with Other in Table 2-6; the relatively fewer conditions in the UDOH ED dataset for Table 2-13; and the majority blank records available for 'providers seen' in Table 2-23.

11.4.2 Examined New Process Versus the Existing NHAMCS Data Collection Process

Minimal processing is required to adapt the ED dataset to NHAMCS needs. Most calculations are similar to those used with the NHAMCS (e.g., percent distribution of visits by age and sex; number of visits per 100 persons per year) and these programs can be reused and updated from year to year. Approximately half of NHAMCS PUF tables can be reproduced with the current UDOH ED variables. However, NHAMCS can potentially be fully recreated with UDOH ED data if the following information is acquired: residence address, mode of arrival, triage category, time variables, blood pressure, temperature, pulse oximetry, episode of care (first visit or follow-up), diagnostic and screening services and procedures, medication data, and hospital characteristics. Preliminary investigations suggest most of these factors are captured by Utah and can be provided in subsequent deliveries. We conclude that most of the NHAMCS PUFs can be reproduced with existing UDOH data if the Census Bureau were to acquire these additional variables. This is an exciting finding as it opens up a number of future opportunities and benefits. NHAMCS data have only been published at the state-level one other time (see Products - Data Briefs - Number 252 - June 2016 [cdc.gov]). This suggests that it is worth exploring whether or not additional states would be interested in partnering with the Census Bureau to produce similar tables for their states as well. If enough states were to provide such data, it would save data collection costs on NCHS's end. In addition, since the data are already collected by UDOH, there is no additional respondent burden. Also, since the UDOH ED data include all visits as opposed to NHAMCS which simply collects a sample, there may be enough records that the level of detail in future iterations of the tables could be enhanced. Overall, this research opens up the possibility of a finer level of detail (geographic, demographic, clinical, etc.) for the NHAMCS tables with the added benefits of lower cost and respondent burden. Given this potential, it is well worth the effort to explore future collaboration opportunities in this area.

12 Overall Conclusions

The purpose of our partnership agreement is to use existing UDOH data and available Census Bureau resources to address two aims: 1) to improve understanding of the social determinants of emergency department (ED) utilization in Utah with the goal of identifying factors that may help to reduce "Preventable Emergency Care" visits (defined as ED visits that are "Non-emergent," "Primary Care Treatable," or "Preventable"); and 2) to evaluate the utility of ED encounter data for use with Census Bureau survey collection. We address these aims by creating a linked dataset to evaluate patterns of ED use using the Social Determinants of Health (SDOH) framework (for Aim 1) and testing whether NHAMCS PUF tables could be replicated with 2017 UDOH data (for Aim 2). Aim 1 concludes that ED visits overall and by type are associated with many Social Determinants of Health. Specifically, ED visits vary across education, household income, neighborhood and built environment, social and community context, economic stability, and health and healthcare domains. Aim 2 concludes that 15 out of the 27 NHAMCS PUF tables could be recreated with the current UDOH delivery, and the majority of PUF tables could be replicated with more available Utah components. A couple of the tables could possibly be produced through collaboration with NCHS.

The linked dataset used for Aim 1 provides important value for this project. It provides Utah with sociodemographic context for their ED visits and can potentially be used to inform Utah healthcare policy. The dataset can be used to produce supplemental analyses of the trends in preventable ED visits, such as predicting the likelihood of each type of ED visit or describing the characteristics of Preventable Emergency Care users against Not Preventable ED users. It also has a broader range of benefits for Utah. Knowledge of relationships between SDOH and ED visits can potentially be used by UDOH to optimize procedures and reduce costs from preventable ED visits. For example, approaches to the distribution of medical resources and the dissemination of public health messages could be refined in light of this research. These data can also be used to build profiles of Utah healthcare users and further evaluate how sociodemographic characteristics are related to Utah health and healthcare experiences.

The linked dataset also provides the Census Bureau with highly detailed health and healthcare data for Utah. The strong patterns found in estimating relationships within the linked ED dataset serve to validate ACS topic measurement, and this can help the Census Bureau refine and tailor its survey questions and develop new survey content.

The unlinked dataset used for Aim 2 highlights potential respondent burden and cost benefits if the additional variables needed to fully replicate the NHAMCS PUF tables are available with the UDOH data. With full replication of the tables, the NHAMCS may no longer require field data collection at Utah hospitals, saving Utah providers the time cost and burden of participating in the survey. The UDOH data also offer a number of potential additional applications, assuming all approvals are in place. First, since the Medical Record Number (MRN) is available on both the UDOH data received by the Census Bureau, as well as the 2017 NHAMCS internal files collected by the Census Bureau, should the NCHS IRB approve, the NHAMCS and UDOH data could be linked. This would allow a direct comparison of records that are abstracted for the 2017 NHAMCS to those obtained by the UDOH. This would be a very helpful quality assessment, particularly for NHAMCS.

On a related point, and also assuming the proper approvals were to be obtained, the UDOH data could potentially be useful for NCHS to help them assess the current imputation procedures they use on the

NHAMCS data collected by the Census Bureau. A more immediate outcome of this work is that NCHS could consider publishing these state-level tables on their NHAMCS website where data users could easily access them. Public health data users have expressed strong desire to have ambulatory medical care data at geographic levels smaller than the nation. NCHS could publish these Utah tables which might also encourage additional states to provide similar data.

In a more general sense, this work demonstrates how existing survey data can be enhanced with administrative records data, and vice versa, to support insights into the social determinants of health (SDOH). Applying statistical analysis to the combined UDOH ED-ACS dataset reveals important data trends not observable from studying the UDOH ED data or ACS alone. The main innovation comes from our ability to attach SDOH characteristics at the individual rather than aggregate geographic level and from doing so on a scale larger than previous work.

The findings of both aims are limited by a few caveats. One caveat is that, although this research uses fairly current data (i.e., 2013-2017), even more recent datasets are now available. Our earlier data may not reflect the current health and healthcare context of Utah. This is especially true given the impact of the COVID-19 pandemic on the United States and its healthcare system.

For Aim 1, additional limitations are that: 1) ICD-9 and ICD-10, rather than ICD-11, are used to assign primary diagnoses; 2) out-of-state patients are excluded from most analyses; and 3) a restricted model of ED visits was used. First, the ICD-11 is the most recent disease classification system and was published in 2018 (WHO, 2020). However, we use ICD-9 and ICD-10 because they pertain to the study's data years (i.e., 2013-2017). Second, out-of-state patients are excluded from the study's core analyses. Out-of-state residents account for a small number, and share, of patients. Nevertheless, excluding this group from most analyses limits our ability to examine why out-of-state patients visit Utah EDs and whether their trips were for Preventable Emergency Care. And third, while our models focus on preventable and not preventable ED visit types, we could also allow for subcategories related to the other five NYU ED categories (i.e., Mental-Health, Alcohol, Substance-Abuse, Injury, and Unclassified).

Aim 2's limitations are that: 1) the exact number of replicable NHAMCS PUF tables is still undetermined, and 2) the real-world impact of substituting NHAMCS data collection for UDOH ED data was not assessed. First, some tables were not recreated because of missing or blank UDOH ED data. We estimate that additional tables can be constructed, but could not confirm their replicability due to data limitations. Second, we did not assess the logistics of substituting traditional NHAMCS survey data collection for UDOH ED data during a production cycle. We speculate that switching survey methodology in Utah may reduce provider burden for Utah EDs and cut data collection-related costs for the NHAMCS sponsor, NCHS. However, the actual cost and savings associated with this change are undetermined. In particular, the potential cost of changing methodology and impact on time-series NHAMCS data has not been assessed.

Looking ahead, research linking the Utah dataset(s) with yet other survey microdata that provide more contextual information could yield additional benefits. Such linkage work could fall into a few broad categories: checking the validity of existing survey data; studying relationships among PIK matching, SDOH and ED use; assessing the quality of PIK matching; and evaluating the relationship between SDOH and other healthcare outcomes. First, the Census Bureau's Household Pulse Survey was administered weekly in the spring and summer of 2020, and its topics included the social and economic experience of households during the COVID-19 pandemic (Census Bureau, 2020c). Second, the Survey of Income and

Program Participation (SIPP) captures information about the economic well-being, families, health insurance, and food security (Census Bureau, 2020d). Third, the Current Population Survey Annual Social and Economic Supplement (CPS ASEC; CPS, 2017) collects information on a variety of topics, including health insurance coverage and self-reported health. Lastly, as discussed within this paper, NHAMCS collects data on a variety of health and healthcare topics related to hospitals and emergency departments (Bureau of Labor Statistics & Census Bureau, 2017). Linking any of these surveys with the UDOH would provide a valuable resource for comparing Utah health and healthcare characteristics against items from Census Bureau surveys.

Another direction for future research is to study relationships among PIK matching, SDOH and ED use. It may be the case that PIK matching success is a residual factor associated with ED use, while controlling for our SDOH factors. In addition, it could be useful to evaluate the success of PIK matching for different types of UDOH data, specifically with regards to with and without social security numbers, other characteristics, and by groups in an effort to evaluate PIKing success with Utah datasets.

Another research opportunity is to refine our models such that they also estimate effects for all NYU ED visit types. While our models classify ED visits using Preventable Emergency Care and Not Preventable categories, approximately 44% of ED visits fall into five NYU ED supplemental categories (i.e., Mental-Health, Alcohol, Substance-Abuse, Injury, and Unclassified). An expanded model could also evaluate how Social Determinants of Health are related to these other categories of ED visits.

Finally, linking the ACS to Utah-specific NEMSIS EMS data (i.e., National Emergency Medical Services Information System Emergency Medical Services data) or to UDOH hospital data could enable valuable insight for healthcare policy about non-ED health outcomes. These datasets would allow researchers to answer questions about how Social Determinants of Health are related to the use of other healthcare facilities and whether hospital-related NHAMCS tables can be replicated with a broader set of Utah variables.

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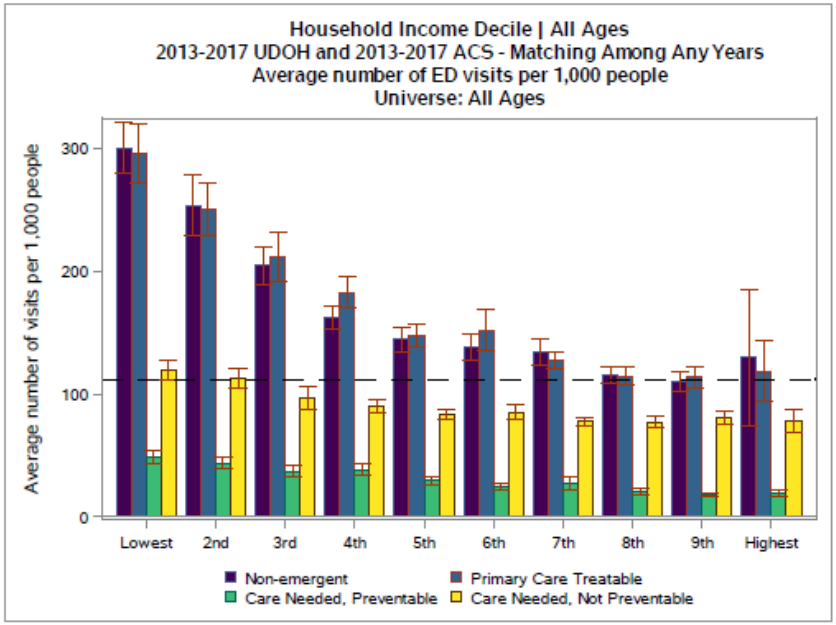
Appendix A: Aim 1 Figures



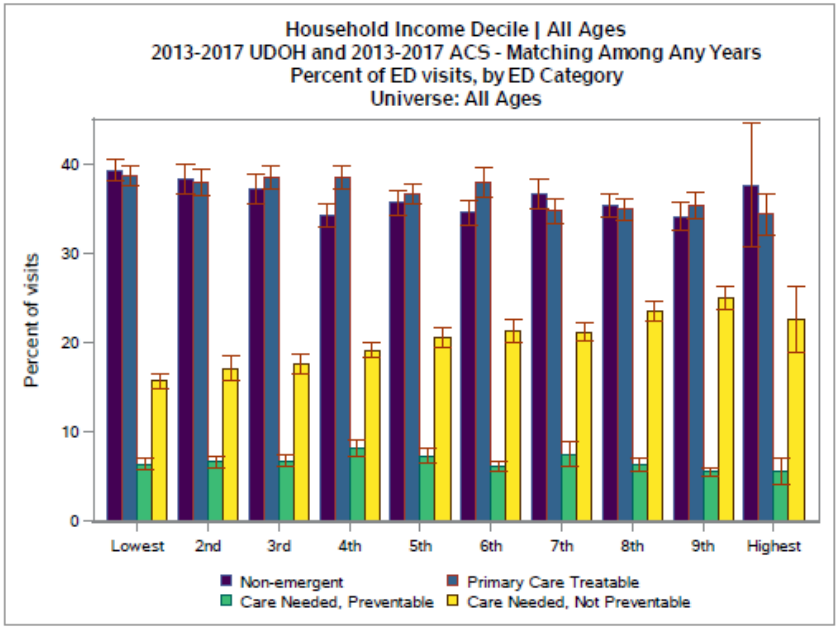


Figure 2. Average number of visits per 1,000 people by household income decile

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

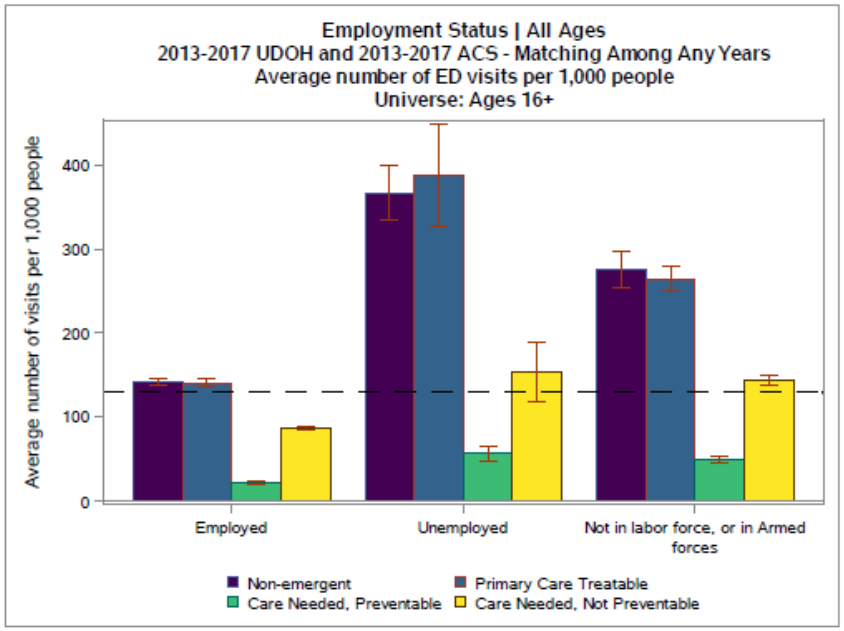
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits, in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 3. Percent of ED visits by household income decile

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



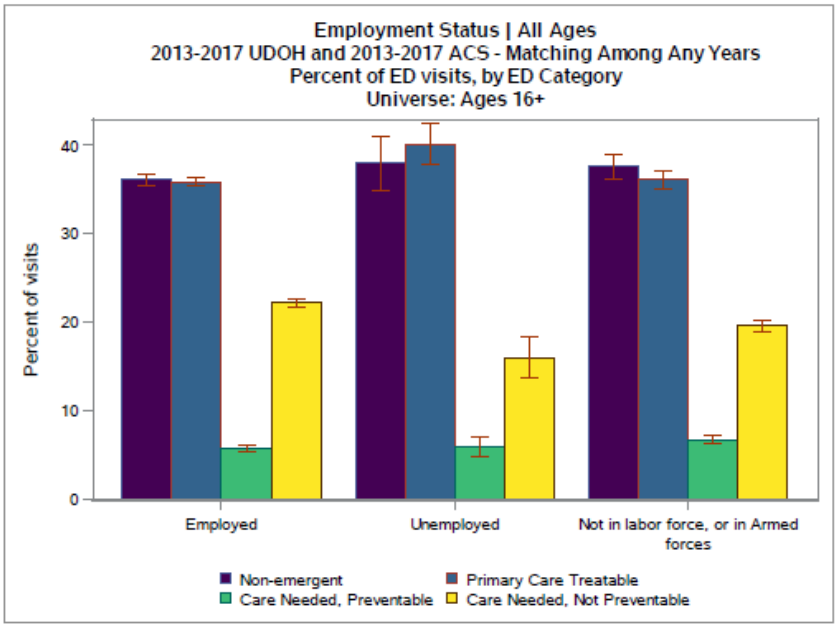


Figure 4. Average number of visits per 1,000 people by employment status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

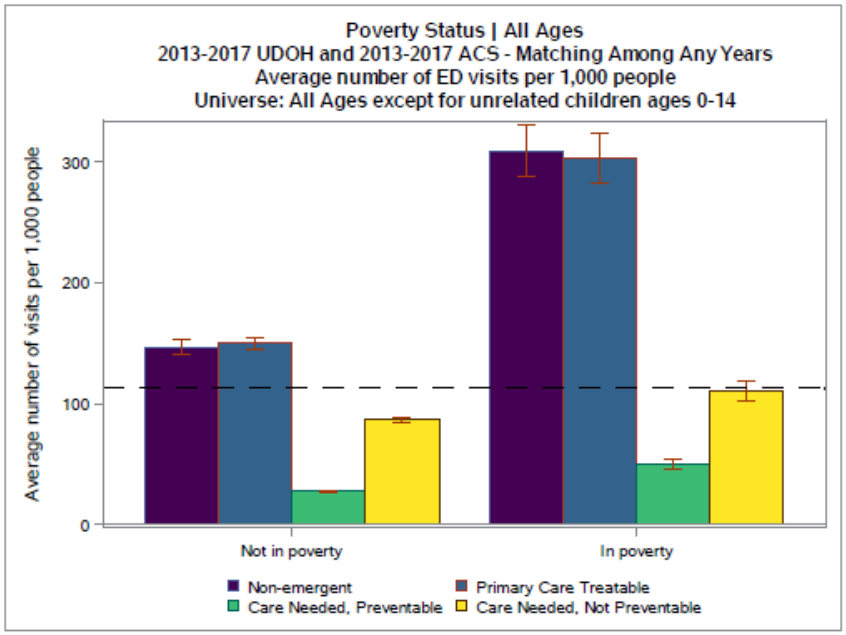
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 5. Percent of ED visits by employment status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



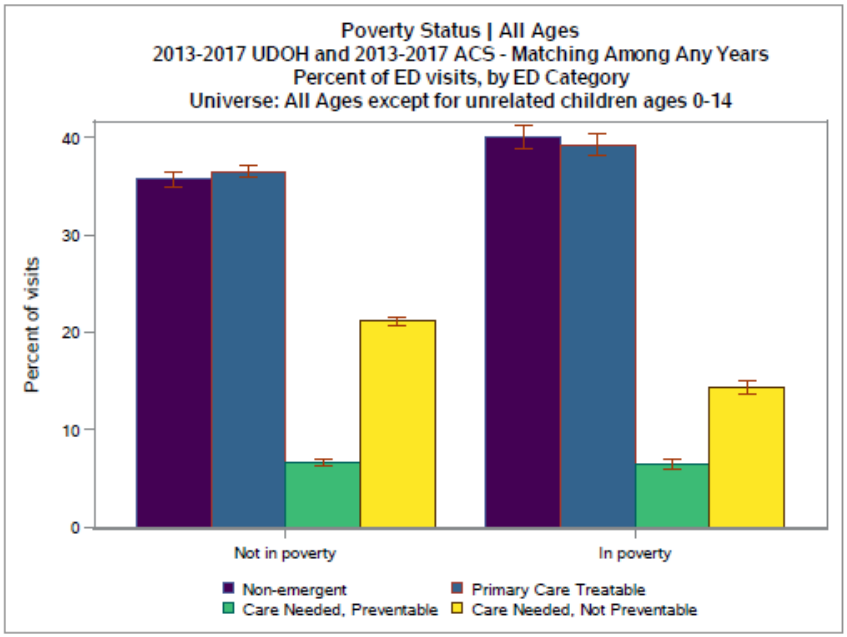


Figure 6. Average number of visits per 1,000 people by poverty status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

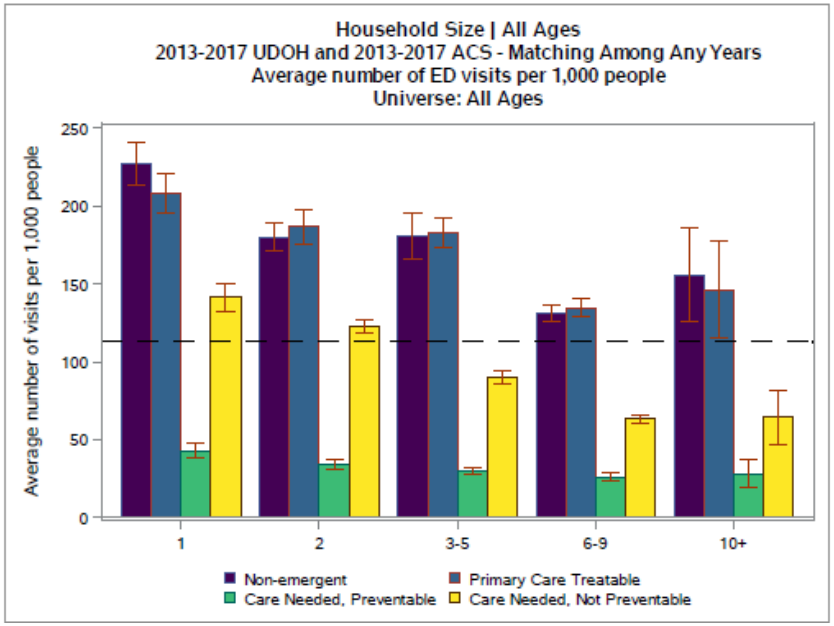
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 7. Percent of ED visits by poverty status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



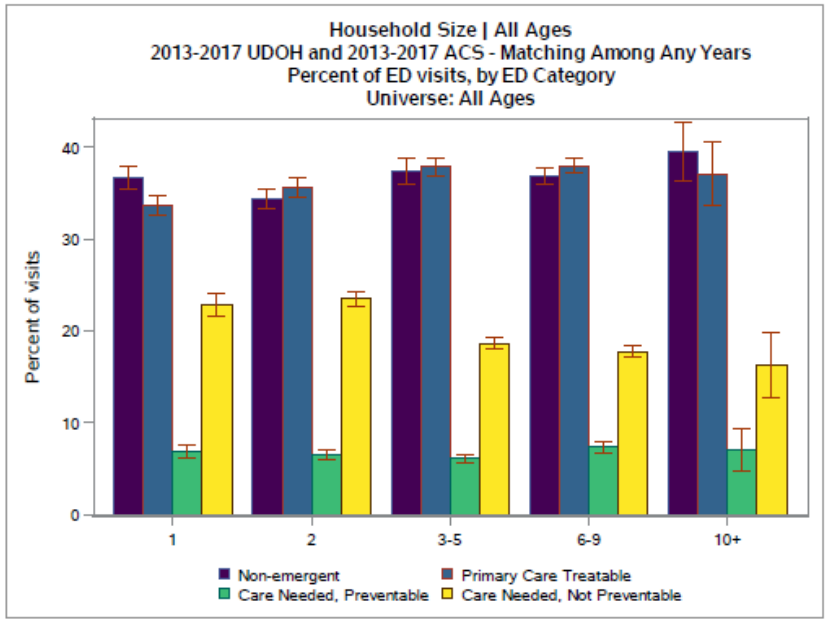


Figure 8. Average number of visits per 1,000 people by household size

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

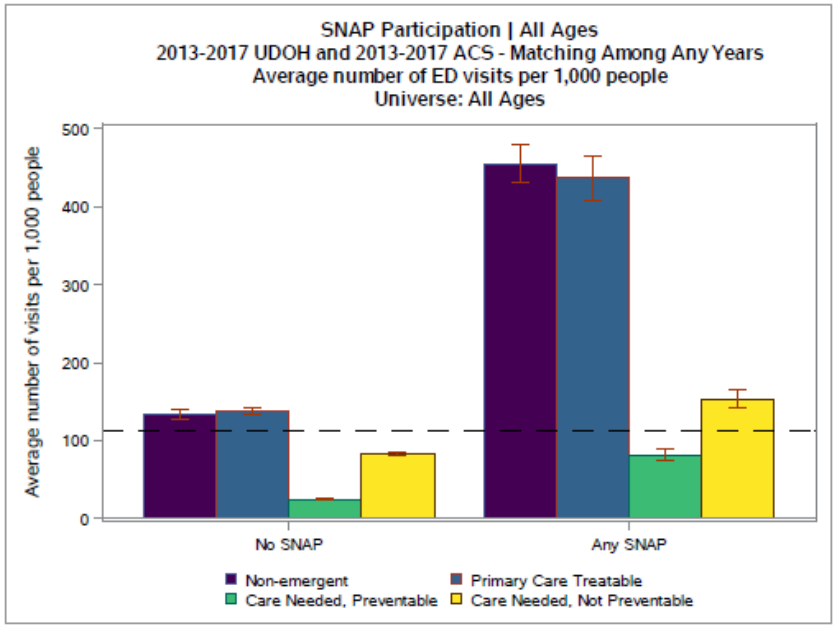
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 9. Percent of ED visits by household size

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



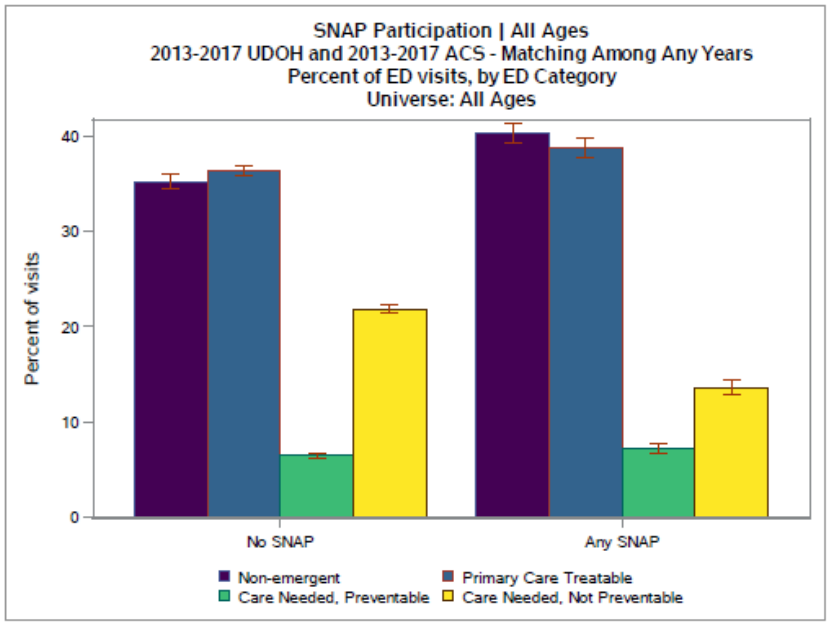


Figure 10. Average number of visits per 1,000 people by SNAP participation

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

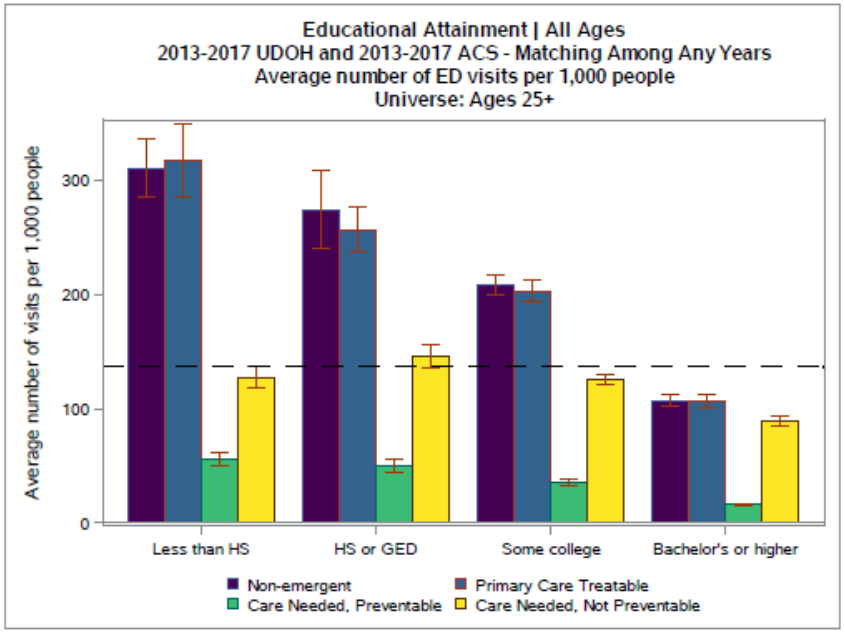
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 11. Percent of ED visits by SNAP participation

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



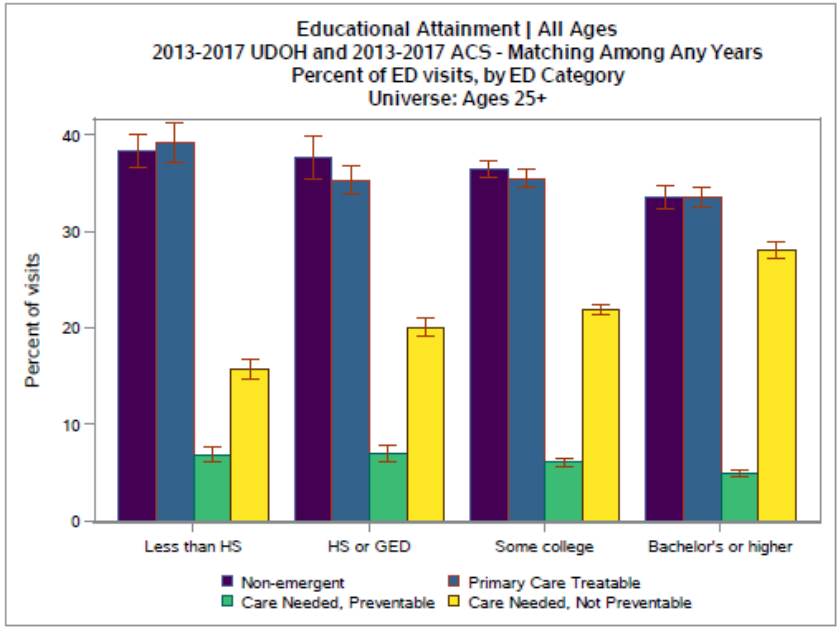


Figure 12. Average number of visits per 1,000 people by educational attainment

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

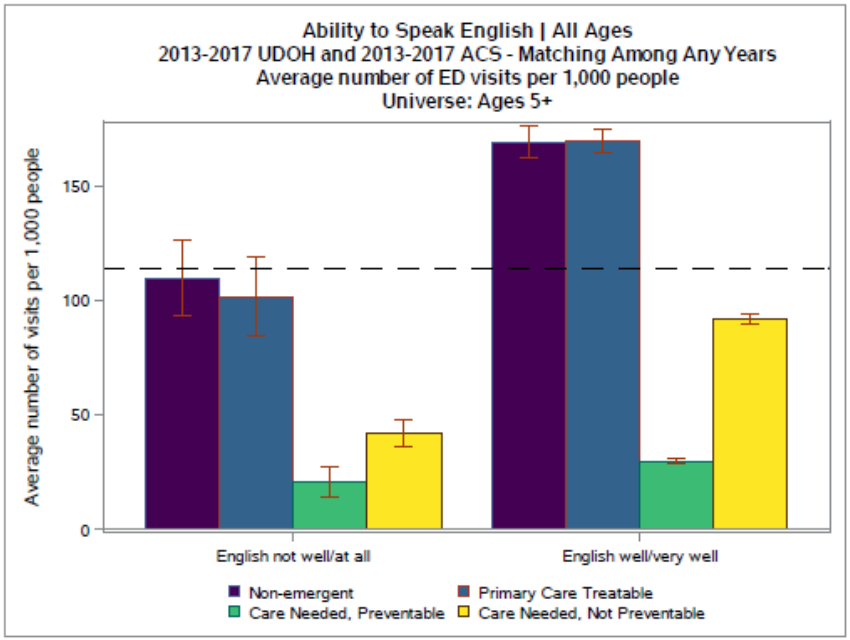
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 13. Percent of ED visits by educational attainment

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



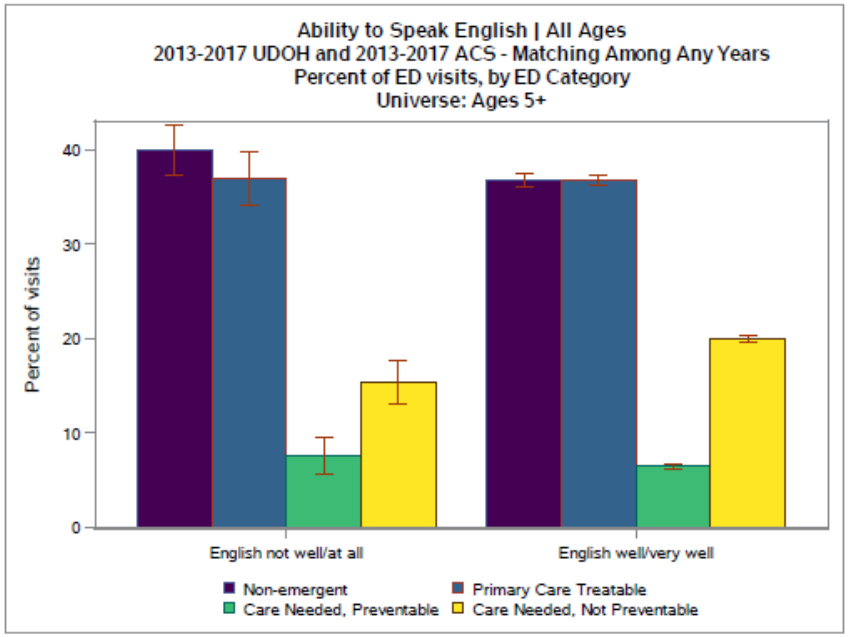


Figure 14. Average number of visits per 1,000 people by ability to speak English

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

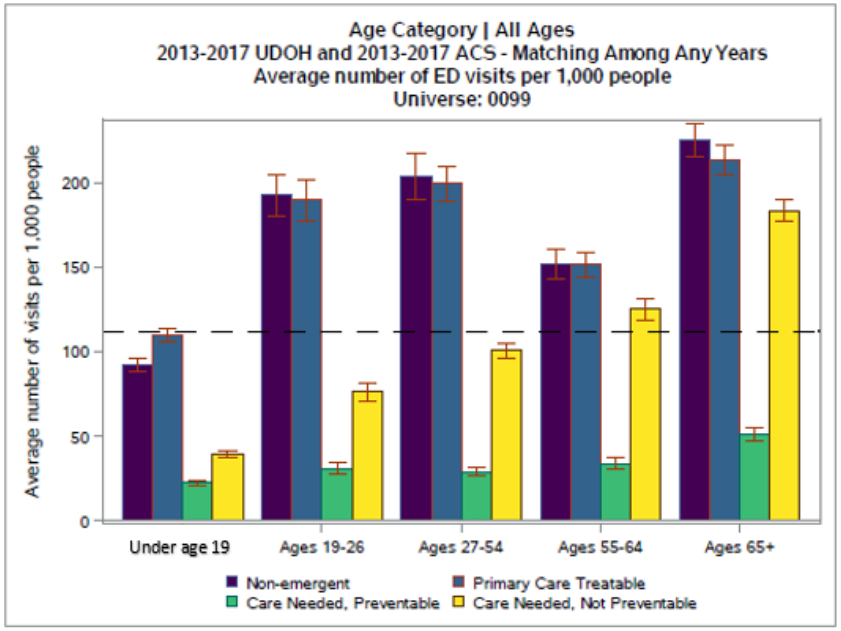
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 15. Percent of ED visits by ability to speak English

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



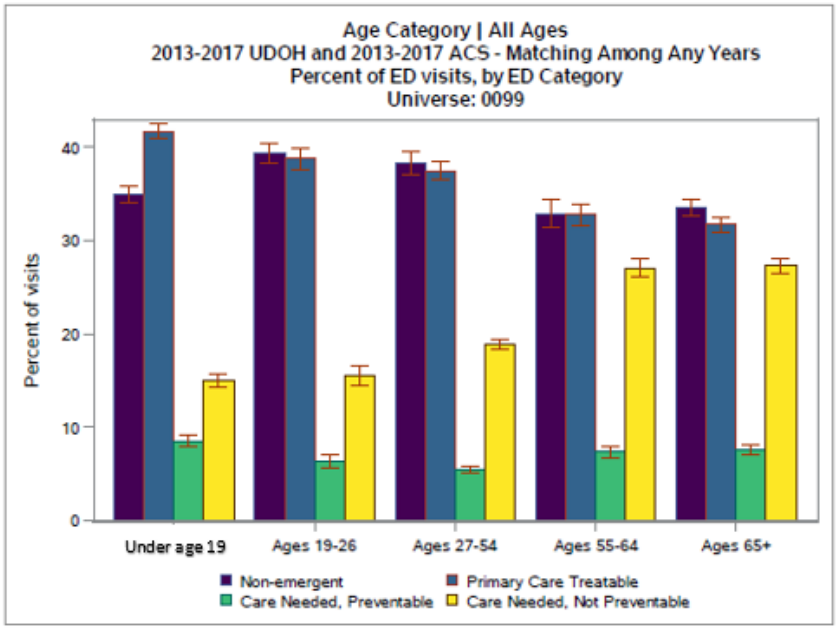


Figure 16. Average number of visits per 1,000 people by age category

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

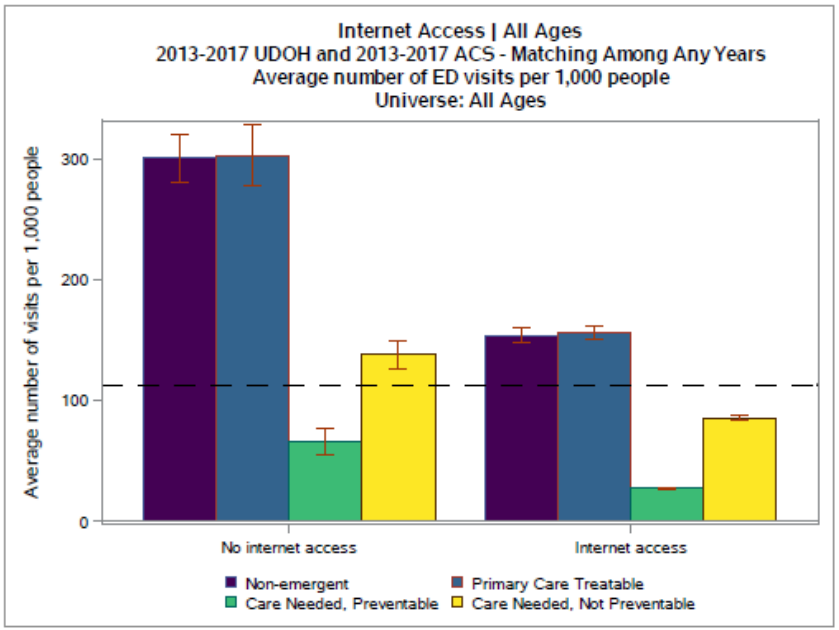
Return to Section 5.1 (Aim 1 Results)
Return to Section 5.2 (Comparison of Any Year Linked Data to Same Year Linked Data) Return to Section 5.3 (Examination of Variation by Age)

Figure 17. Percent of ED visits by age category

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

Return to Section 5.1 (Aim 1 Results)
Return to Section 5.2 (Comparison of Any Year Linked Data to Same Year Linked Data) Return to Section 5.3 (Examination of Variation by Age)



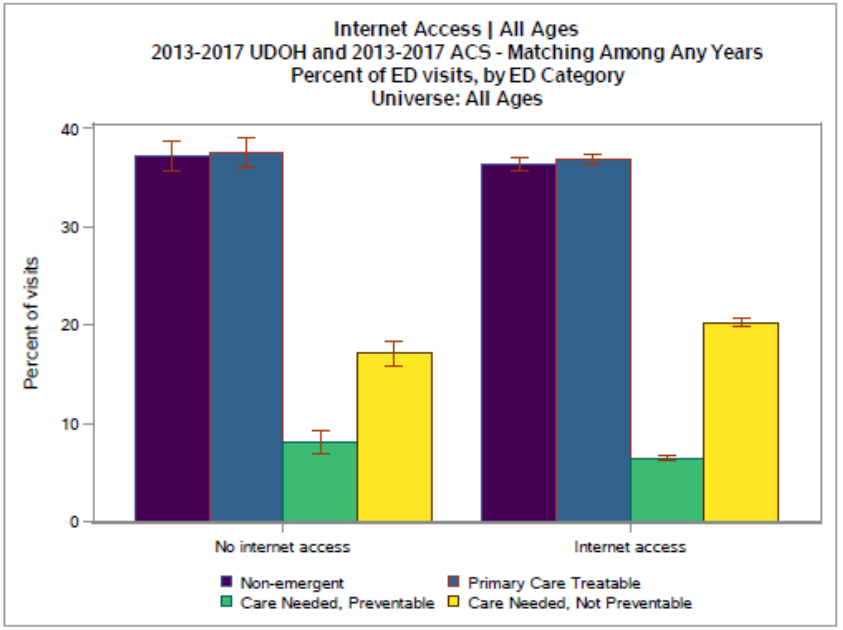


Figure 18. Average number of visits per 1,000 people by internet access

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

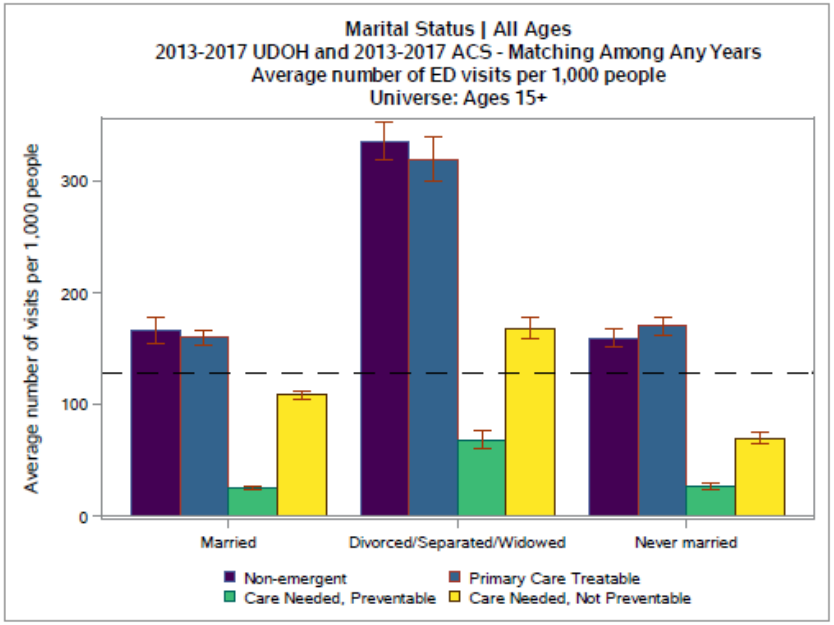
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 19. Percent of ED visits by internet access

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



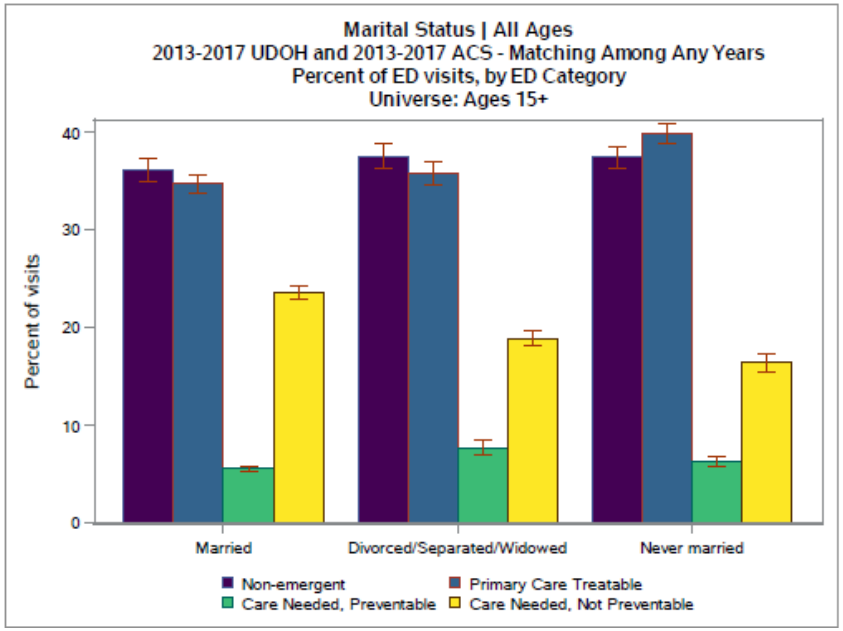


Figure 20. Average number of visits per 1,000 people by marital status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

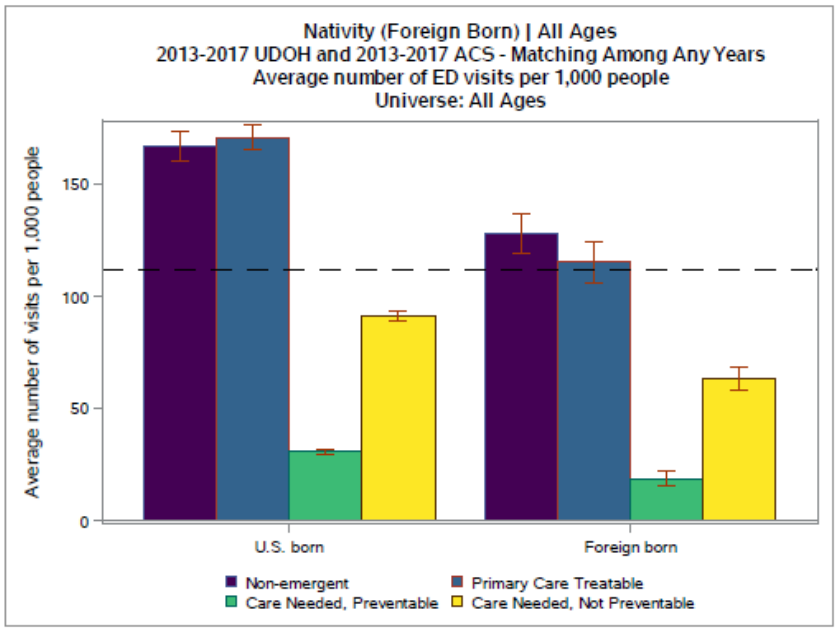
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 21. Percent of ED visits by marital status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



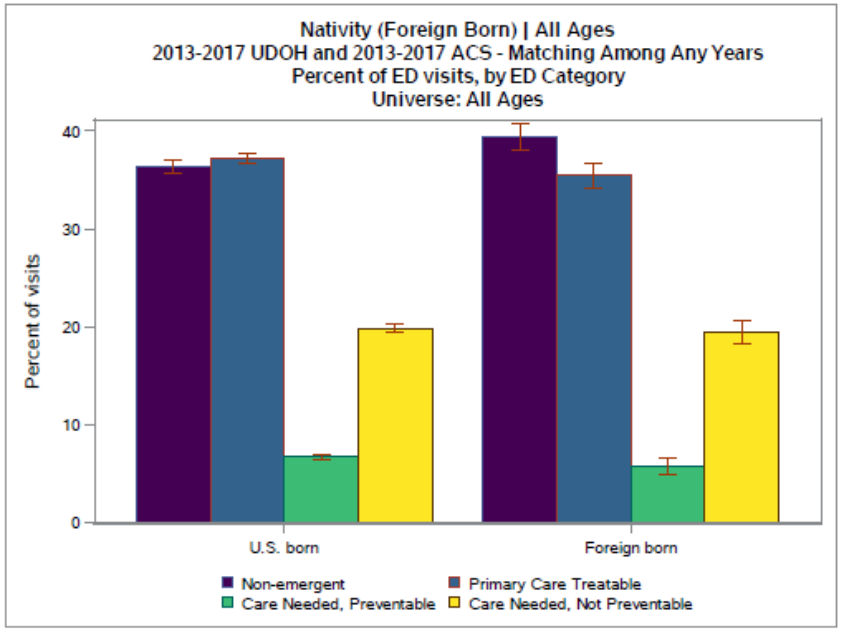


Figure 22. Average number of visits per 1,000 people by nativity (foreign born)

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

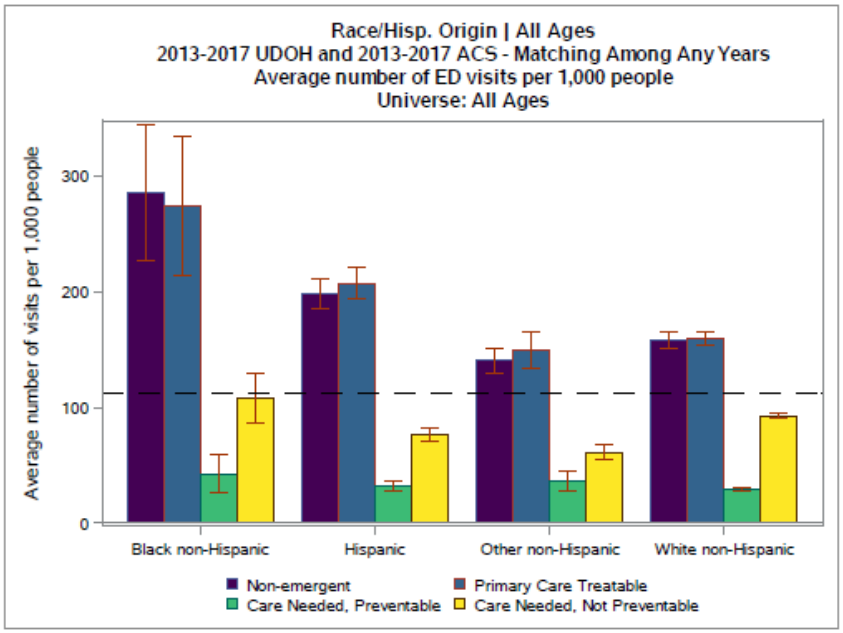
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 23. Percent of ED visits by nativity (foreign born)

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



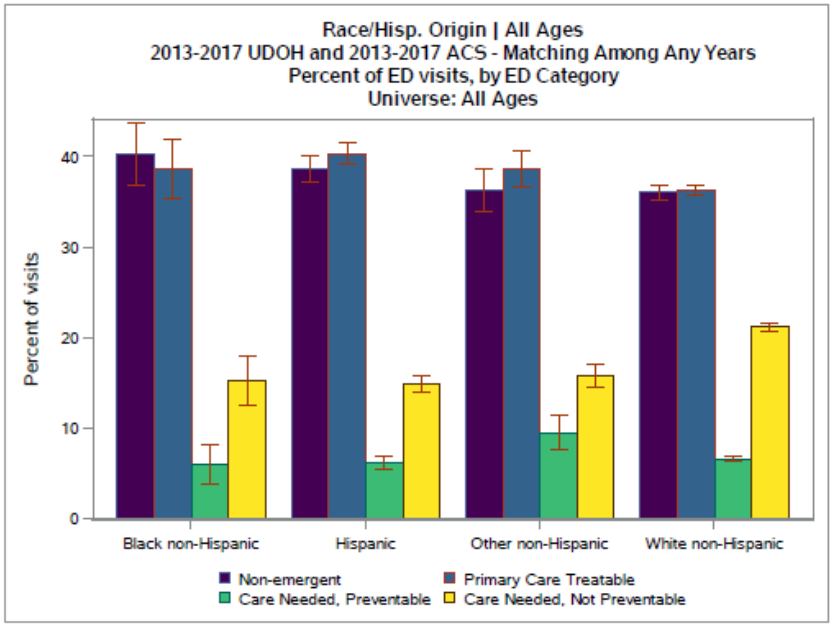


Figure 24. Average number of visits per 1,000 people by race and Hispanic origin

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

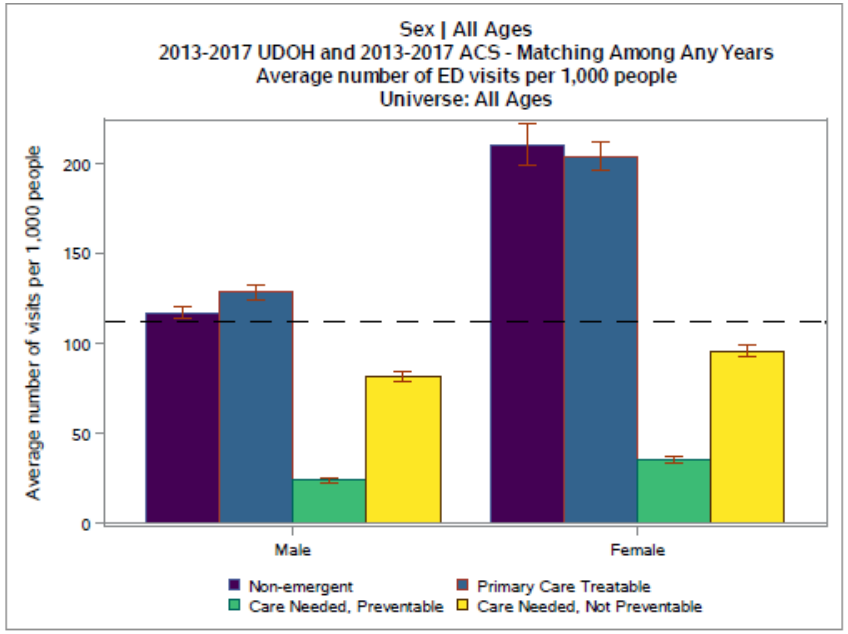
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 25. Percent of ED visits by race and Hispanic origin

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



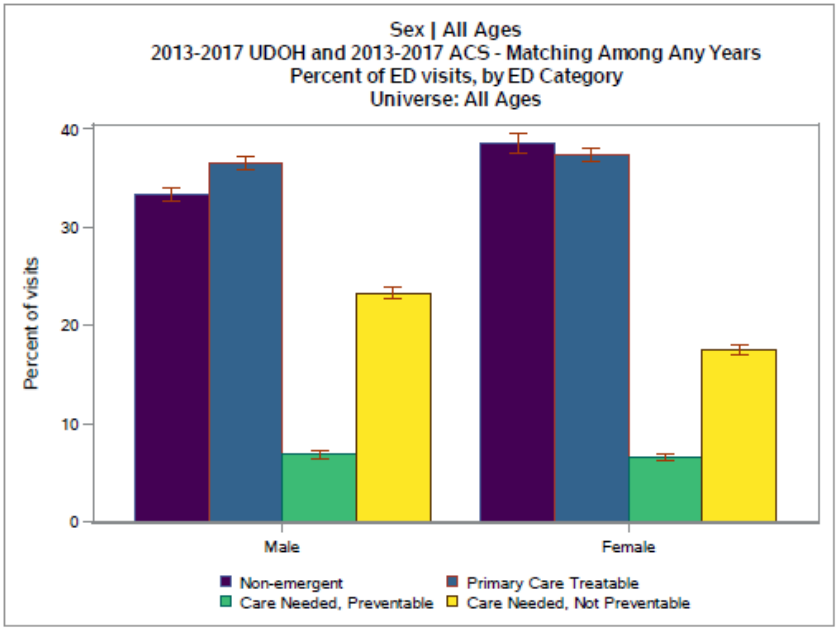


Figure 26. Average number of visits per 1,000 people by sex

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

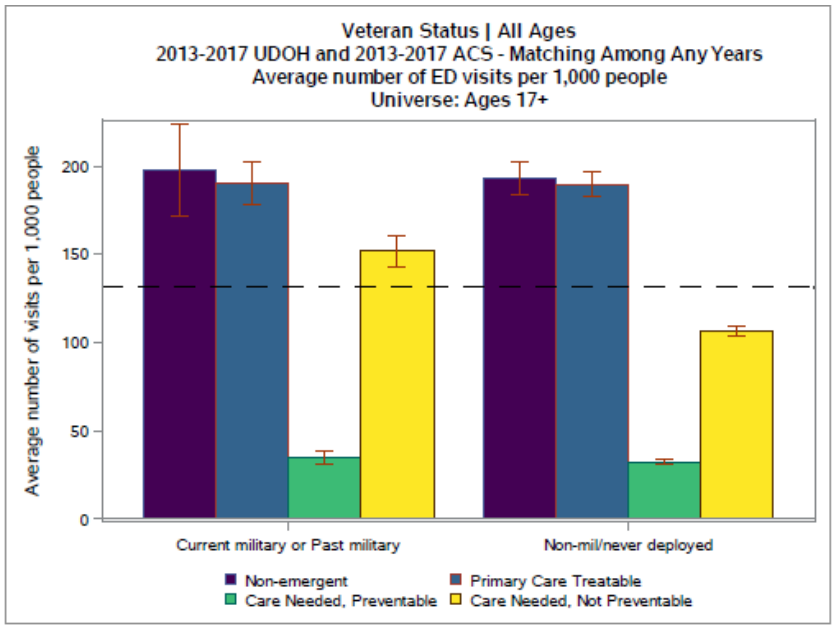
Return to Section 5.1 (Aim 1 Results) ↵ Return to Section 5.3 (Examination of Variation by Age) ↵

Figure 27. Percent of ED visits by sex

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

Return to Section 5.1 (Aim 1 Results) ↵
Return to Section 5.3 (Examination of Variation by Age) ↵



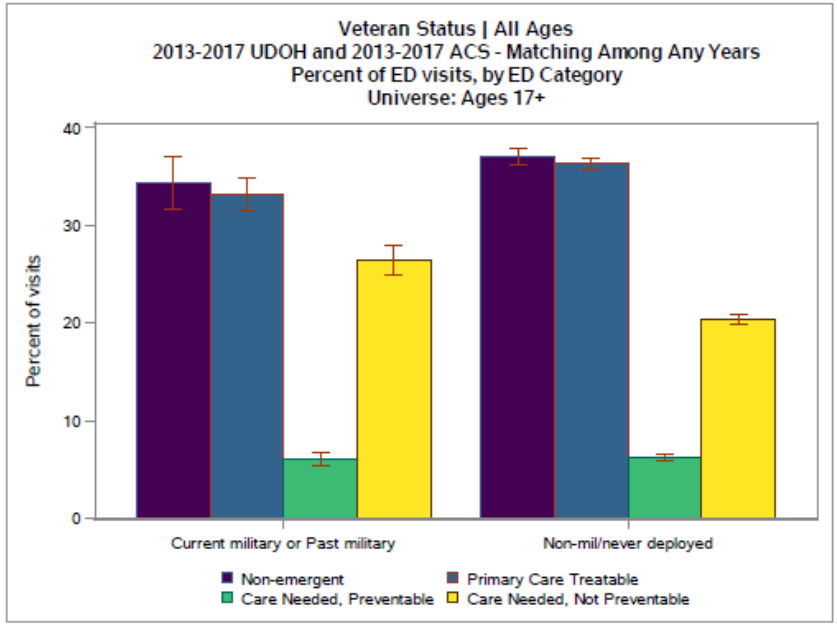


Figure 28. Average number of visits per 1,000 people by current military experience or past (veterans)

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Notes: 1. For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

2. The Veteran category is comprised of individuals with past or current military background.

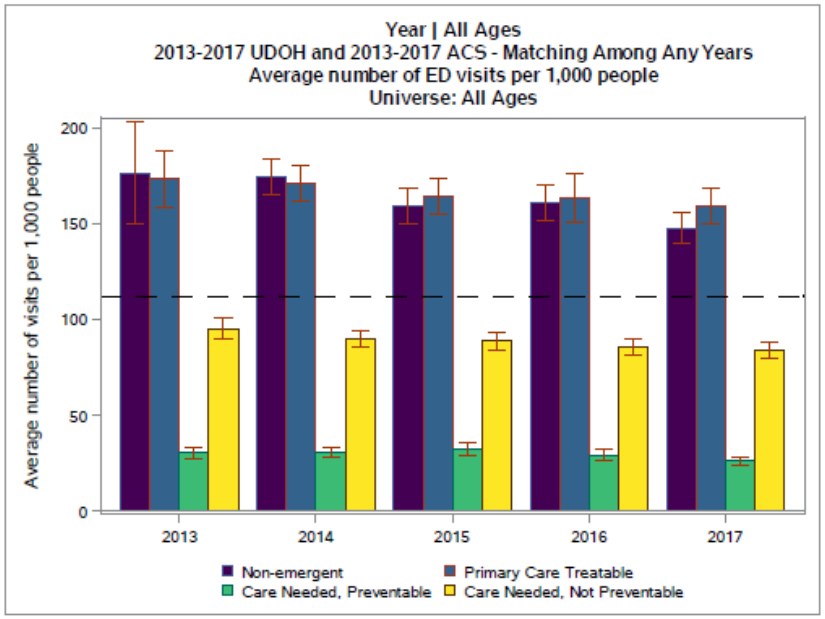
*The dashed reference line is the average number of visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 29. Percent of ED visits by current military experience or past (veterans)

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Notes: 1. For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

2. The Veteran category is comprised of individuals with past or current military background.



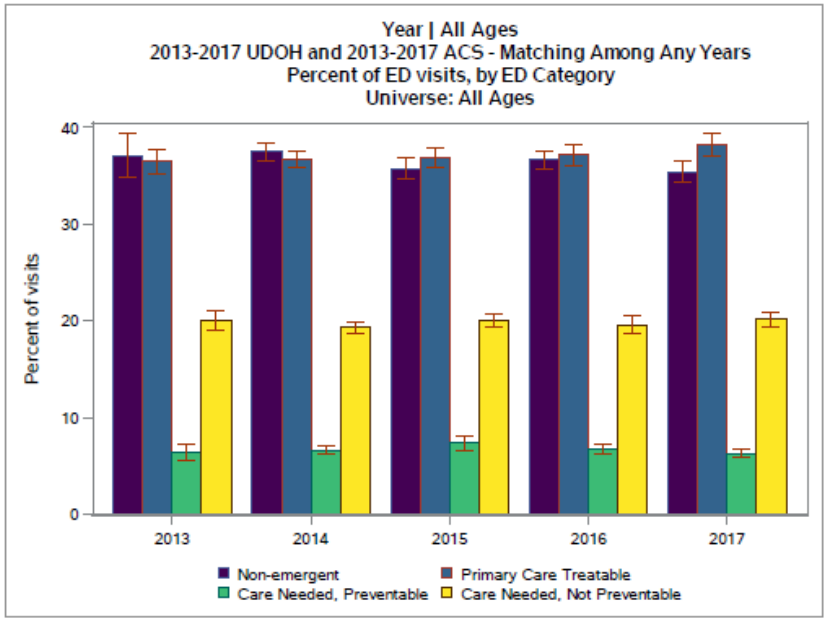


Figure 30. Average number of visits per 1,000 people by year

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

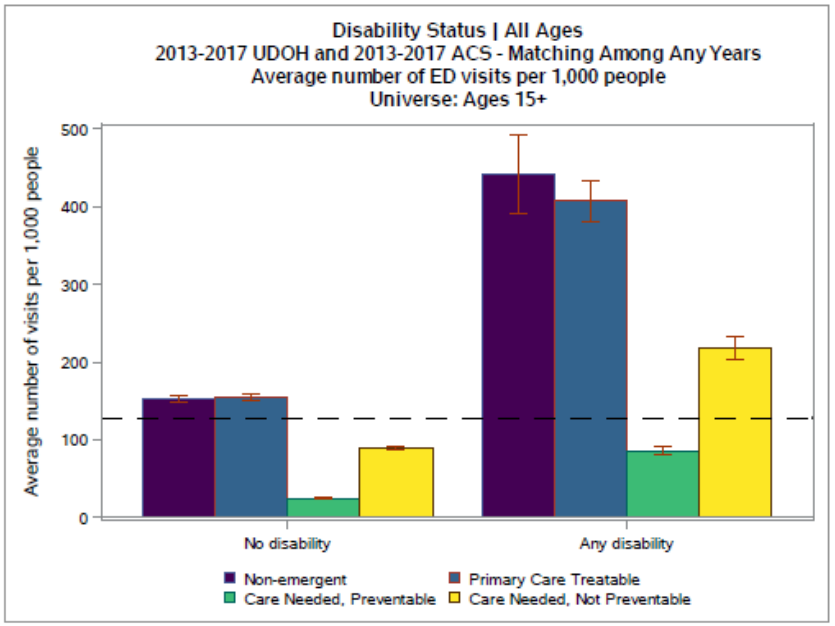
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 31. Percent of ED visits by year

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



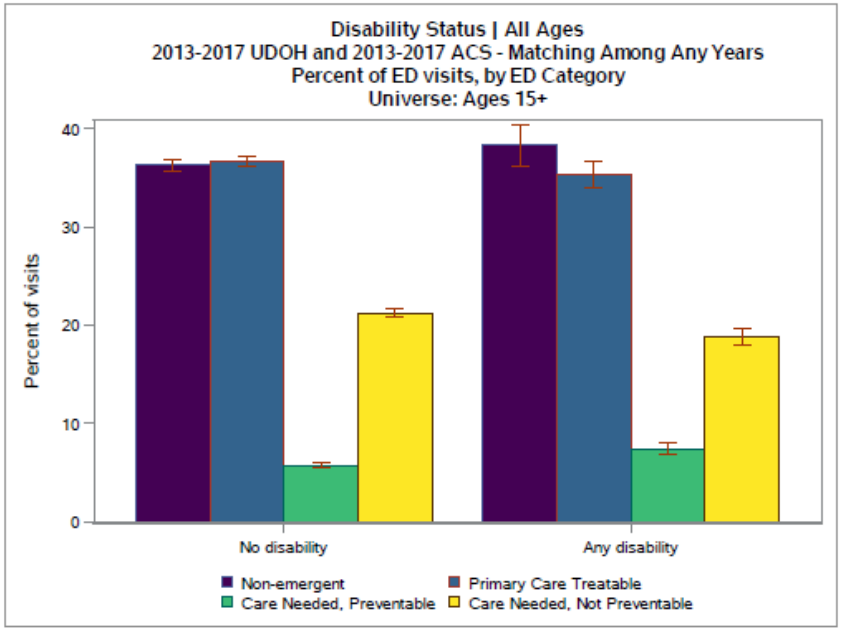


Figure 32. Average number of visits per 1,000 people by disability status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

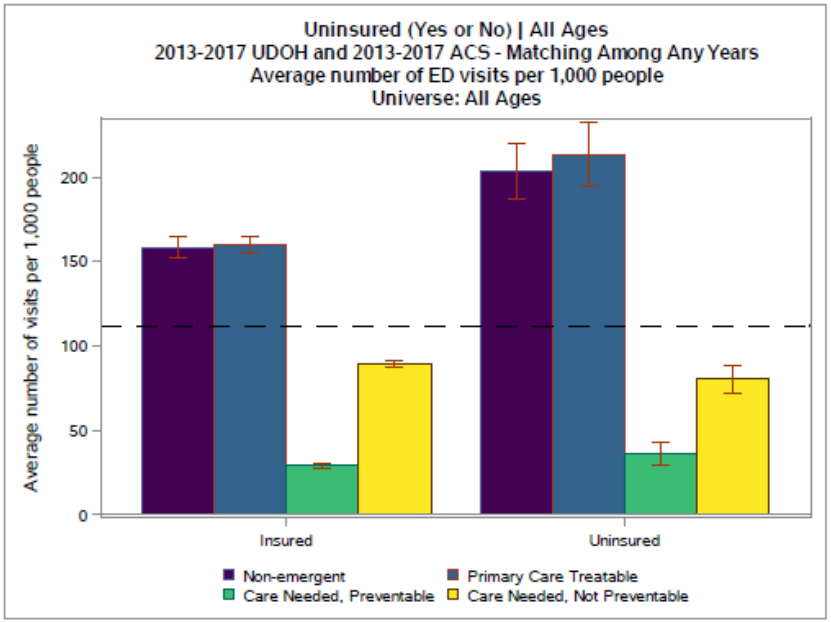
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 33. Percent of ED visits by disability status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



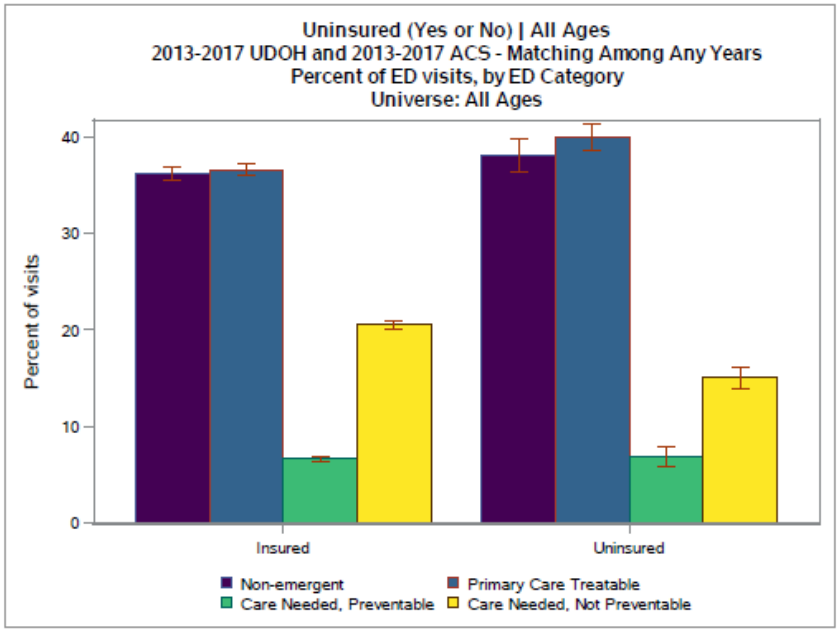


Figure 34. Average number of visits per 1,000 people by health insurance status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

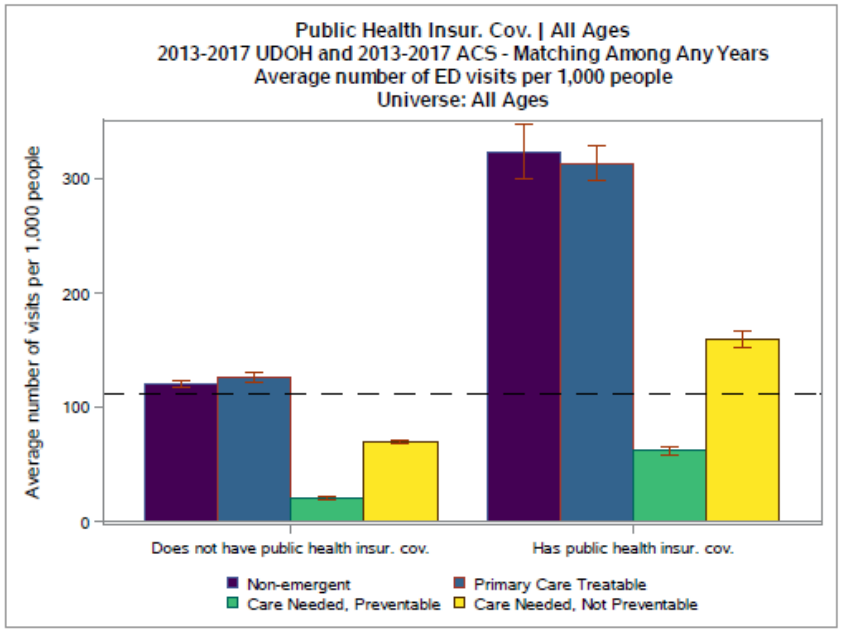
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 35. Percent of ED visits by health insurance status

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



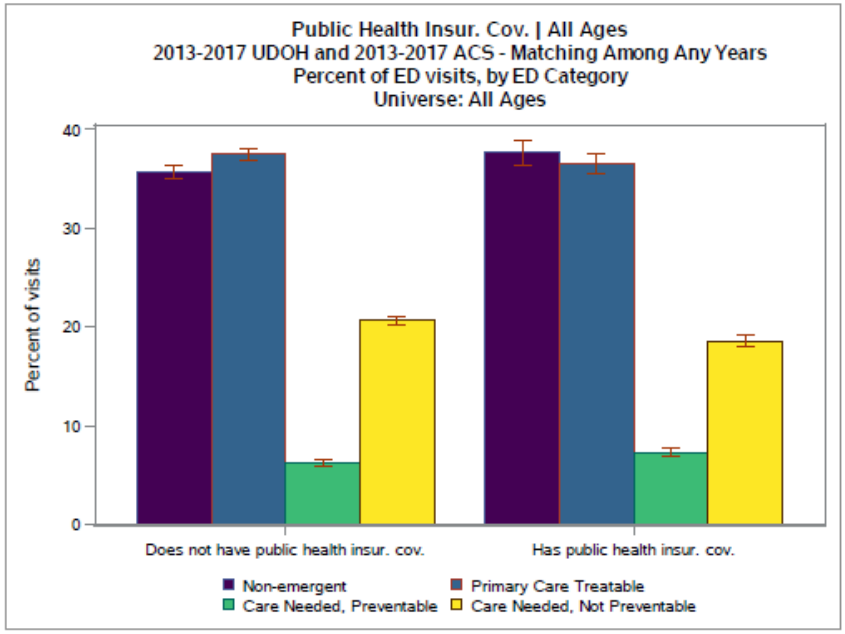


Figure 36. Average number of visits per 1,000 people by public health coverage

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

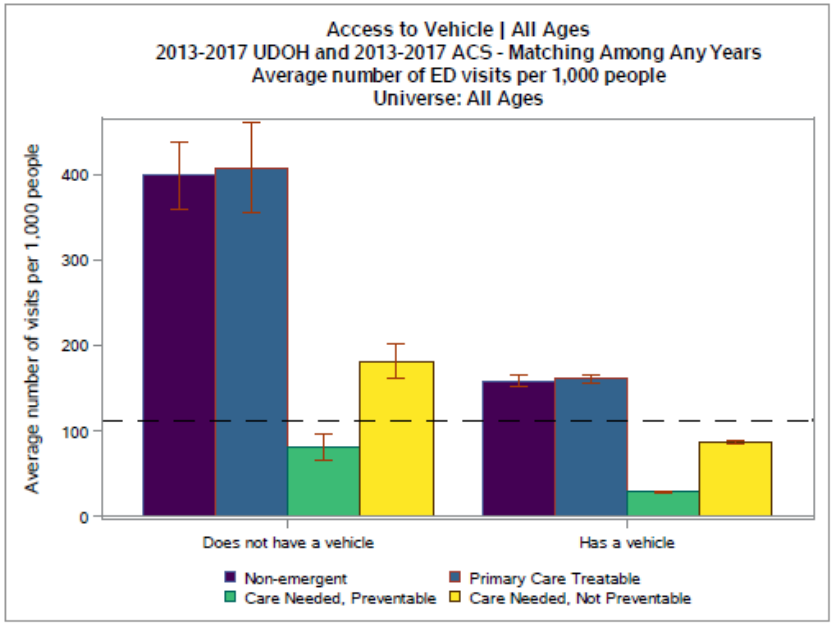
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 37. Percent of ED visits by public health coverage

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



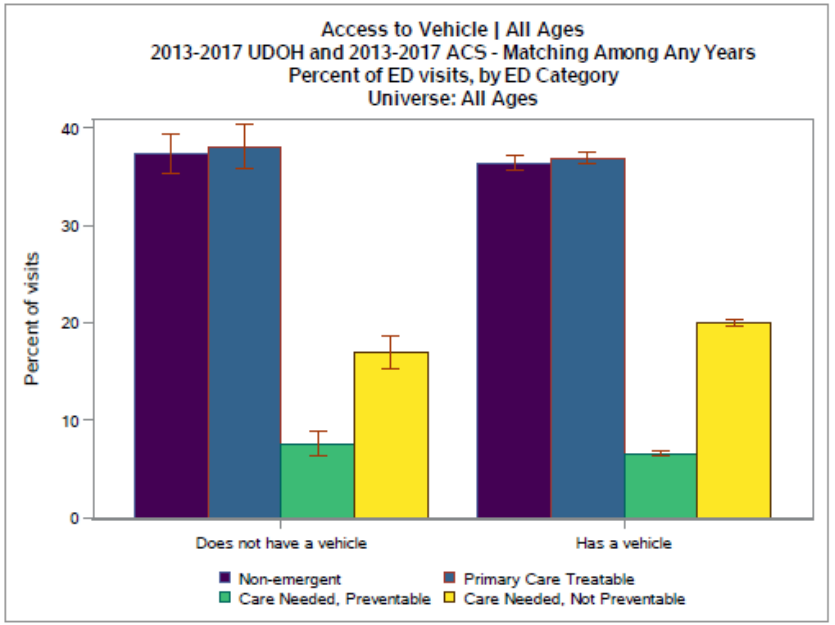


Figure 38. Average number of visits per 1,000 people by vehicle access

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

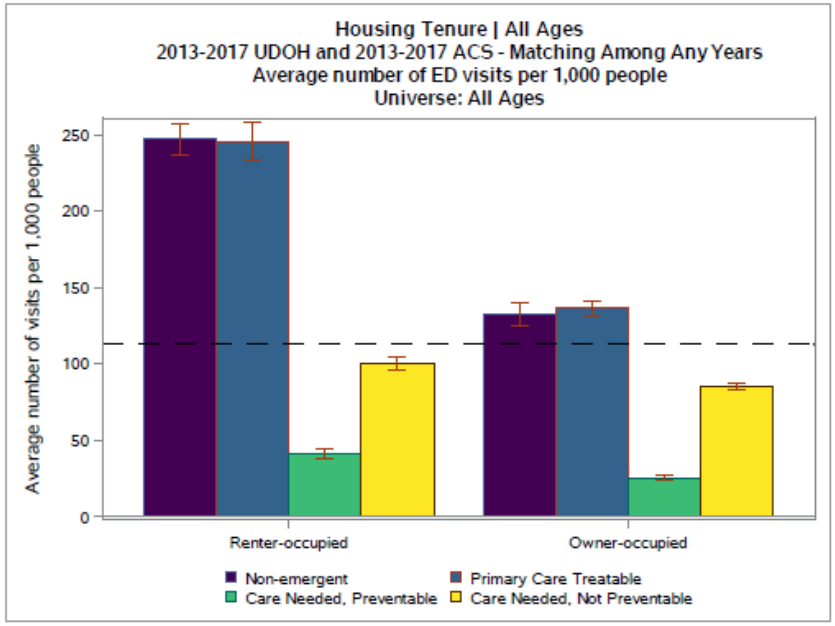
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 39. Percent of ED visits by vehicle access

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



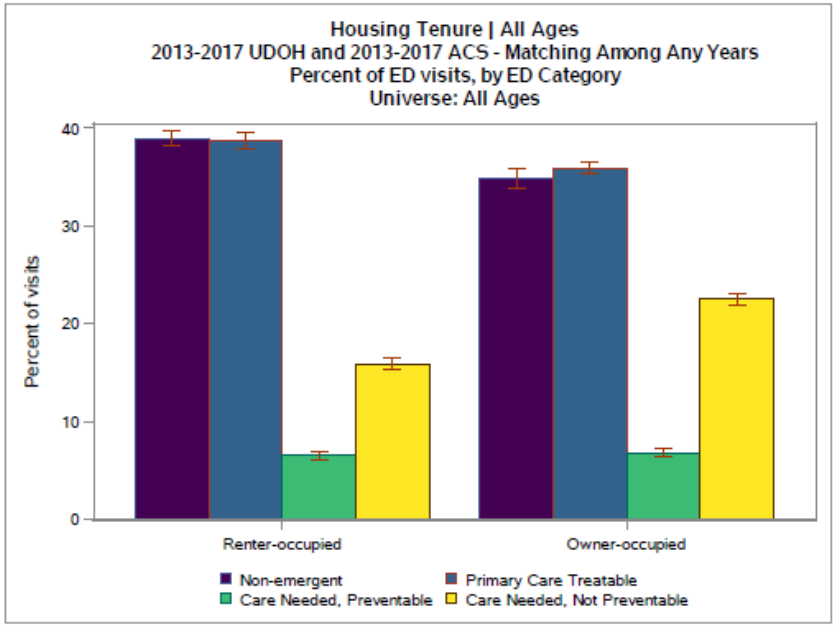


Figure 40. Average number of visits per 1,000 people by housing tenure

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

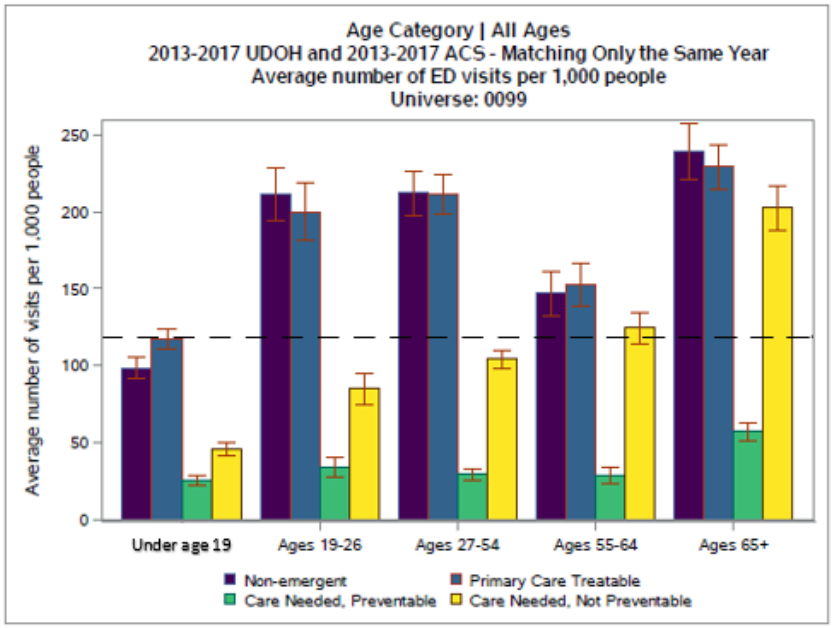
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 41. Percent of ED visits by housing tenure

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



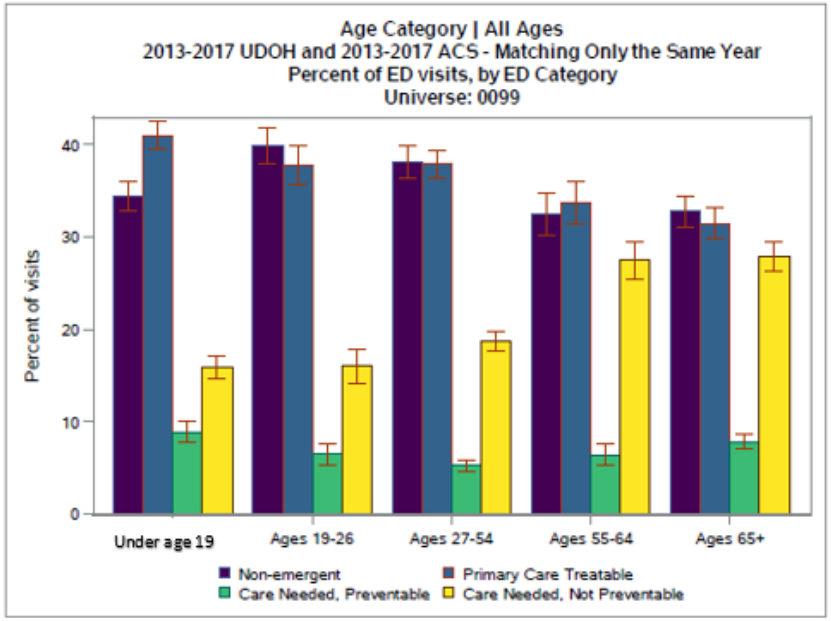


Figure 42. Average number of visits per 1,000 people by age category, same year-linked dataset

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

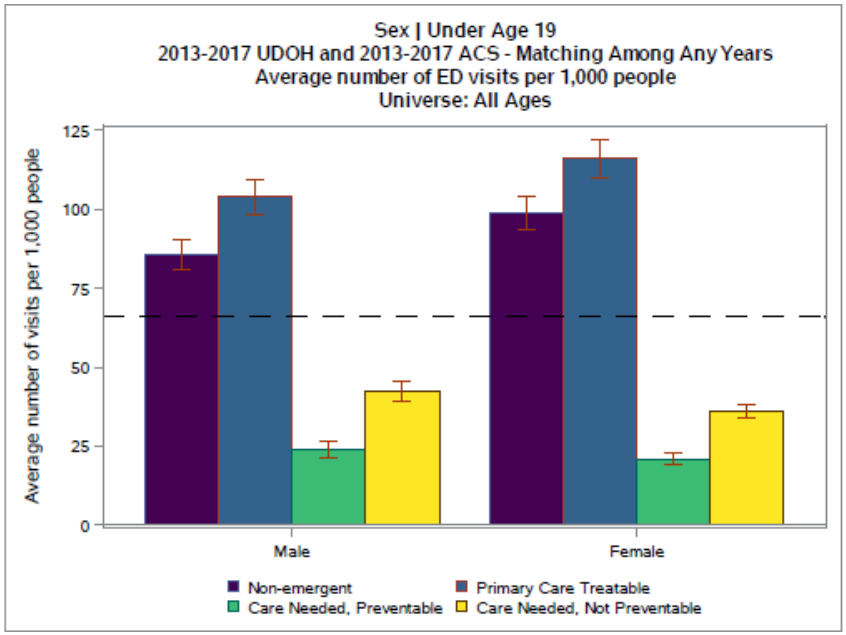
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 43. Percent of ED visits by age category, same year-linked dataset

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



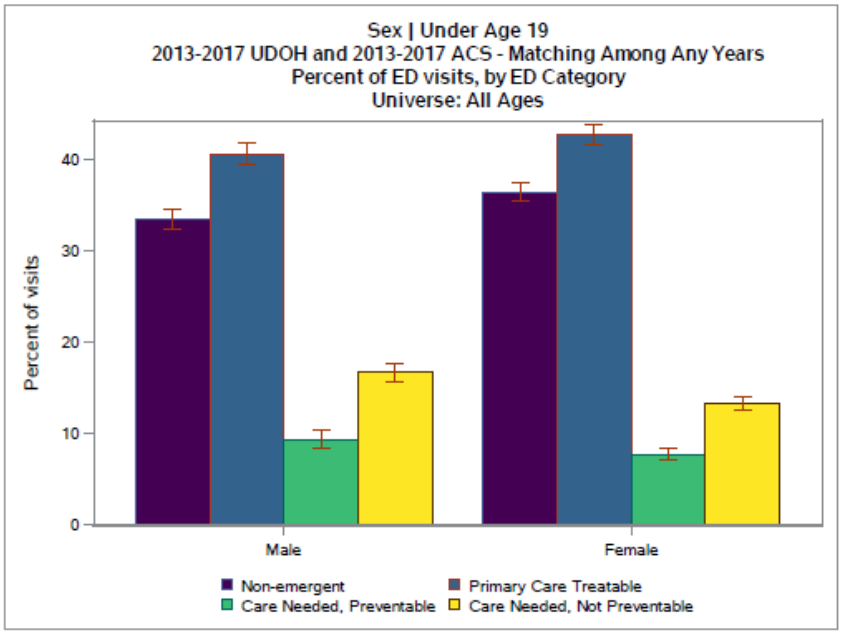


Figure 44. Average number of visits per 1,000 people by sex, under 19 years

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

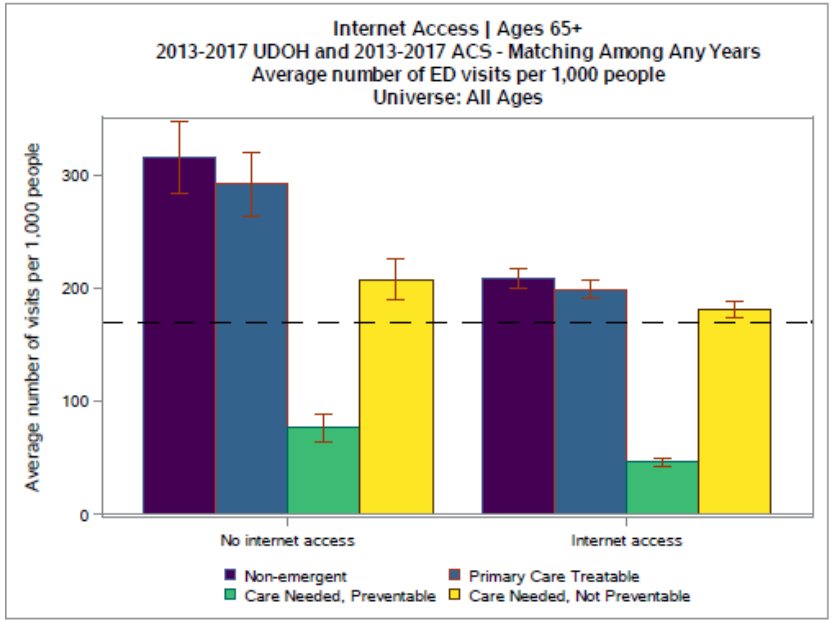
Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 45. Percent of ED visits by sex, under 19 years

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).



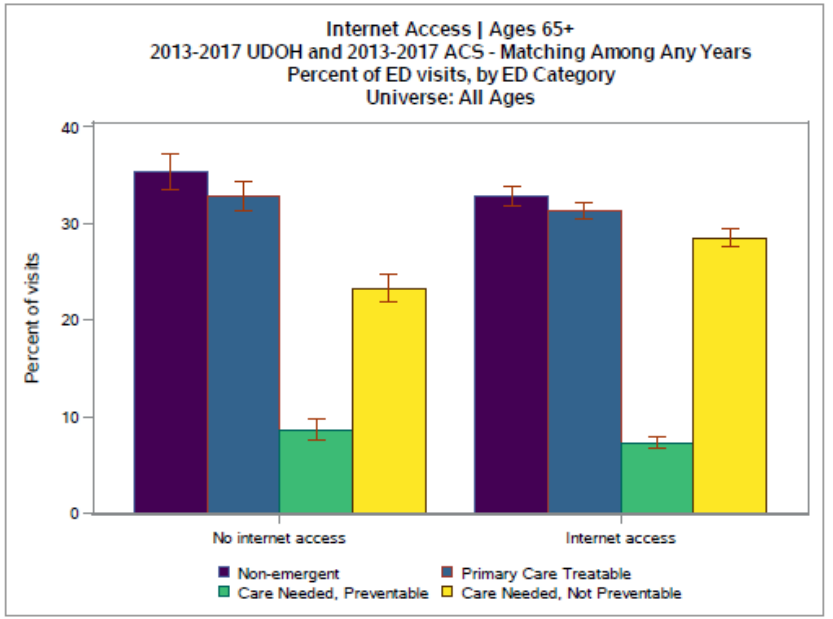


Figure 46. Average number of visits per 1,000 people by internet access, 65 years and older

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

*The dashed reference line is the average number of visits, 115 ED visits in the four categories (Non-emergent, Primary Care Treatable, Preventable, Not Preventable) per 1,000 people.

Figure 47. Percent of ED visits by internet access, 65 years and older

Source: Utah Department of Health (UDOH) (2018), Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2013-2017 (2018). U.S. Census Bureau (2018), 2013, 2014, 2015, 2016, and 2017 American Community Survey (ACS), for Individual 1-Year Estimates (2018).

Note: For information on ACS confidentiality protection, error, etc., see U.S. Census Bureau (2018).

Appendix B: Aim 2 Tables

Table 2-1. Emergency department visits, by selected characteristics: Utah, 2017

Characteristic	Number of visits	Percent distribution	Number of visits per 100 persons per year
All visits	**736000**	**100**	**23.7**
Metropolitan Status			
MSA	637000	86.5	22.9
Non-MSA	99000	13.5	30.5
Season			
Winter	180000	24.5	5.8
Spring	189000	25.7	6.1
Summer	194000	26.4	6.3
Fall	174000	23.6	5.6

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Notes: The 2017 ACS 1-year estimates for Utah (data.census.gov) were used as the denominator for the number of visits per 100 persons per year for all visits and by season. The 2017 county population totals were used as the denominator for the number of visits per 100 persons per year for metropolitan status (https://www.census.gov/data/datasets/time-series/demo/popest/2010s-counties-total.html). Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-2. Emergency department visits, by patient age, sex, and residence: Utah, 2017

Patient Characteristic	Number of visits	Percent distribution	Number of visits per 100 persons per year
Age group (years)			
All visits	**736000**	**100**	**23.7**
Under 15	131000	17.8	16.9
Under 1	19500	2.6	.
1-4	48500	6.6	19.2
5-14	63500	8.6	12.2
15-24	114000	15.5	22.8
25-44	235000	31.9	26.8
45-64	148000	20.1	24.1
65 and over	108000	14.7	32.2
65-74	53500	7.3	26.5
75 and over	54500	7.4	40.9
Female	**407000**	**55.3**	**26.5**
Under 15	60000	14.7	16.0
15-24	69000	17.0	28.4
25-44	138000	33.9	31.8
45-64	79500	19.5	25.9
65-74	29000	7.1	27.3
75 and older	31500	7.7	42.7
Male	**329000**	**44.7**	**21.0**
Under 15	71000	21.6	17.8
15-24	45000	13.7	17.4
25-44	96500	29.3	21.7
45-64	68500	20.8	22.3
65-74	24500	7.4	25.6
75 and older	23000	7.0	38.6
Urban-Rural Classifications			
Metropolitan			
Large central metro	288000	39.1	.
Large fringe metro	27500	3.7	.
Medium metro	289000	39.3	.
Small metro	69500	9.4	.
Nonmetropolitan			
Micropolitan	74000	10.1	.
Noncore	52500	7.1	.
Blank or unknown	**2200**	**0.3**	.

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Notes: The 2017 ACS 1-year estimates for Utah (data.census.gov) were used as the denominator for the number of visits per 100 persons per year. Urban-rural classifications in the NHAMCS PUF table are different from the ACS classifications and therefore the 'number of visits per 100 persons per year' could not be calculated. Percent

distribution is based on rounded counts and therefore may not add up to 100 because. Sub-categories may not sum to total due to rounding.

Table 2-3. Emergency department visits, by patient race, age, and ethnicity: Utah, 2017

Patient Characteristic	Number of visits	Percent distribution	Number of visits per 100 persons per year
All visits	**736000**	**100**	**23.7**
Race and age group (years)			
White	**606000**	**82.3**	**22.8**
Under 15	99000	16.3	15.4
15-24	88500	14.6	21.3
25-44	192000	31.7	25.9
45-64	125000	20.6	23.0
65-74	48000	7.9	25.3
75 and over	52500	8.7	41.4
Black or African American	**17500**	**2.4**	**46.5**
Under 15	3400	19.4	31.7
15-24	3400	19.4	43.2
25-44	6200	35.4	63.2
45-64	3600	20.6	47.8
65-74	500	2.9	42.7
75 and over	250	1.4	45.6
Other	**73000**	**9.9**	**23.2**
Under 15	16000	21.9	19.3
15-24	12500	17.1	22.6
25-44	26000	35.6	24.7
45-64	13500	18.5	24.3
65-74	3300	4.5	31.3
75 and over	2300	3.2	42.5
Ethnicity			
Hispanic or Latino	68000	9.2	15.7
Not Hispanic or Latino	460000	62.5	17.2
White	419000	91.1	17.3
Black or African American	10500	2.3	29.4
Other	30500	6.6	15.0

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Notes: The 2017 ACS 1-year estimates for Utah (data.census.gov) were used as the denominator for the number of visits per 100 persons per year. Percent distribution is based on rounded counts and therefore may not add up to 100. Sub-categories may not sum to total due to rounding.

Table 2-6. Expected source of payment at emergency department visits: Utah, 2017

Payment Source	Number of visits	Percent of visits
All visits	**646000**	**100**
Private Insurance	228000	35.3
Medicaid or CHIP	154000	23.8
Medicare	133000	20.6
No insurance (including self-pay and no charge)	86500	13.4
Other (including worker's compensation)	26000	4.0
Unknown or blank	19500	3.0

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.
Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.
Note: Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-10. Ten principal reasons for emergency department visits, by patient age and sex: Utah, 2017

Principal reason for visit	RVC Code	Number of visits	Percent distribution
All visits		**736000**	**100**
Unspecified abdominal pain	R109	48000	6.5
Chest pain, unspecified	R079	25000	3.4
Headache	R51	22500	3.1
Cough	R05	21500	2.9
Fever, unspecified	R509	17500	2.4
Shortness of breath	R0602	12000	1.6
Low back pain	M545	9600	1.3
Unspecified injury of head, initial encounter	S0990XA	9400	1.3
Dorsalgia, unspecified	M549	8800	1.2
Dizziness and giddiness	R42	8500	1.2
All other reasons	...	553000	75.1
All visits under age 15 years	**...**	**131000**	**100.0**
Female		**60000**	**45.8**
Fever, unspecified	R509	6200	4.7
Cough	R05	4400	3.4
Unspecified abdominal pain	R109	2900	2.2
Vomiting, unspecified	R1110	2000	1.5
Unspecified injury of head, initial encounter	S0990XA	1600	1.2
Rash and other nonspecific skin eruption	R21	1300	1.0
Headache	R51	950	0.7
Dyspnea, unspecified	R0600	950	0.7
Laceration without foreign body of other part of head, initial encounter	S0181XA	950	0.7
Acute pharyngitis, unspecified	J029	700	0.5
All other reasons	...	38000	29.0
Male	**...**	**71000**	**54.2**
Fever, unspecified	R509	6500	5.0
Cough	R05	5900	4.5
Unspecified injury of head, initial encounter	S0990XA	2500	1.9
Unspecified abdominal pain	R109	2500	1.9
Vomiting, unspecified	R1110	2100	1.6
Laceration without foreign body of other part of head, initial encounter	S0181XA	1600	1.2
Dyspnea, unspecified	R0600	1500	1.1
Rash and other nonspecific skin eruption	R21	1400	1.1
Headache	R51	950	0.7
Shortness of breath	R0602	800	0.6
All other reasons	...	45500	34.7

Principal reason for visit	RVC Code	Number of visits	Percent distribution
All visits, ages 15-64	**...**	**497000**	**100.0**
Female	**...**	**287000**	**57.7**
Unspecified abdominal pain	R109	25000	5.0
Headache	R51	12500	2.5
Chest pain, unspecified	R079	9800	2.0
Cough	R05	5000	1.0
Shortness of breath	R0602	4200	0.8
Nausea with vomiting, unspecified	R112	4200	0.8
Low back pain	M545	4000	0.8
Dorsalgia, unspecified	M549	3800	0.8
Right lower quadrant pain	R1031	3500	0.7
Dizziness and giddiness	R42	3100	0.6
All other reasons	...	212000	42.7
Male	**...**	**210000**	**42.2**
Unspecified abdominal pain	R109	13000	2.6
Chest pain, unspecified	R079	8600	1.7
Headache	R51	5700	1.1
Low back pain	M545	3800	0.8
Cough	R05	3500	0.7
Dorsalgia, unspecified	M549	3200	0.6
Shortness of breath	R0602	2900	0.6
Suicidal ideations	R45851	2900	0.6
Cervicalgia	M542	2300	0.5
Dizziness and giddiness	R42	2100	0.4
All other reasons	...	162000	32.6
All visits, ages 65 and over	**...**	**108000**	**100.0**
Female	**...**	**60500**	**56.0**
Chest pain, unspecified	R079	3200	3.0
Unspecified abdominal pain	R109	2800	2.6
Shortness of breath	R0602	2000	1.9
Headache	R51	1800	1.7
Dizziness and giddiness	R42	1800	1.7
Weakness	R531	1600	1.5
Cough	R05	1400	1.3
Low back pain	M545	900	0.8
Unspecified injury of head, initial encounter	S0990XA	950	0.9
Dorsalgia, unspecified	M549	950	0.9
All other reasons	...	43000	39.8
Male	**...**	**47500**	**44.0**
Chest pain, unspecified	R079	2800	2.6
Unspecified abdominal pain	R109	2400	2.2
Shortness of breath	R0602	1600	1.5
Dizziness and giddiness	R42	1300	1.2

Principal reason for visit	RVC Code	Number of visits	Percent distribution
Weakness	R531	1200	1.1
Cough	R05	1100	1.0
Headache	R51	800	0.7
Low back pain	M545	650	0.6
Dorsalgia, unspecified	M549	600	0.6
Unspecified injury of head, initial encounter	S0990XA	600	0.6
All other reasons	...	34500	31.9

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.
Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.
Note: Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-11. Primary diagnosis at emergency department visits, by major disease category: Utah, 2017

Major disease category	ICD-10-CM code range	Number of visits	Percent distribution
All visits	**...**	**736000**	**100.0**
Certain infectious and parasitic diseases	A00-B99	13500	1.8
Neoplasms	C00-D49	1100	0.1
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	D50-D89	1600	0.2
Endocrine, nutritional, and metabolic diseases	E00-E89	11500	1.6
Mental, behavioral and neurodevelopmental disorders	F01-F99	35000	4.8
Diseases of the nervous system	G00-G99	23500	3.2
Diseases of the eye and adnexa	H00-H59	5600	0.8
Diseases of the ear and mastoid process	H60-H95	11000	1.5
Diseases of the circulatory system	I00-I99	20000	2.7
Diseases of the respiratory system	J00-J99	63500	8.6
Diseases of the digestive system	K00-K95	46000	6.3
Diseases of the skin and subcutaneous tissue	L00-L95	26000	3.5
Diseases of the musculoskeletal system and connective tissue	M00-M99	47000	6.4
Diseases of the genitourinary system	N00-N99	47500	6.5
Pregnancy, childbirth and the puerperium	O00-O9A	21500	2.9
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	R00-R99	172000	23.4
Injury, poisoning and certain other consequences of external causes	S00-T88	178000	24.2
Injuries to the head	S00-S09	44000	6.0
Injuries to the neck	S10-S19	8000	1.1
Injuries to the thorax	S20-S29	8400	1.1
Injuries to the abdomen, lower back, lumbar spine, pelvis, and external genitals	S30-S39	9100	1.2
Injuries to the shoulder and upper arm	S40-S49	11000	1.5
Injuries to the elbow and forearm	S50-S59	12500	1.7
Injuries to the wrist, hand and fingers	S60-S69	25500	3.5
Injuries to the hip and thigh	S70-S79	4100	0.6
Injuries to the knee and lower leg	S80-S89	14500	2.0
Injuries to the ankle and foot	S90-S99	14500	2.0
Injuries involving multiple body regions or unspecified body region	T01, T14	800	0.1
Effects of foreign body entering through natural orifice	T15-T19	4700	0.6
Burns and corrosions	T20-T32	2300	0.3
Frostbite	T33-T34	90	0.0
Poisoning by, adverse effect of and underdosing of drugs, medicaments and biological substances	T36-T50	6200	0.8
Toxic effects of substance chiefly nonmedicinal as to source	T51-T65	2400	0.3
Other and unspecified effects of external causes	T66-T78	5800	0.8

Major disease category	ICD-10-CM code range	Number of visits	Percent distribution
Certain early complications of trauma	T79	40	0.0
Complications of surgical and medical care	T80-T88	3500	0.5
All other diagnoses	...	11500	1.6
Unknown or blank	...	900	0.1

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Note: Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-12. Annual number and percent distribution of emergency department visits, by diagnosis group: Utah, 2017

Primary diagnosis group	Number of visits	Percent distribution
All visits	**736000**	**100.0**
Certain infectious and parasitic diseases		
Septicemia (sepsis)	750	0.1
Human immunodeficiency virus syndrome (HIV, HIV+, HIV positive)	.D	.
Viral warts, not sexually transmitted	50	0.0
Acute and chronic viral hepatitis, excluding types B and C	60	0.0
Acute and chronic viral hepatitis C	40	0.0
Sexually transmitted infections (STIs) excluding viral hepatitis and HIV	450	0.1
Unspecified viral infection	4800	0.7
Dermatophytosis	300	0.0
Candidiasis	600	0.1
Other systemic infectious and parasitic diseases	6200	0.8
Neoplasms		
Malignant neoplasm of large intestine and rectum	40	0.0
Malignant neoplasm of other digestive organs	60	0.0
Malignant neoplasm of trachea, bronchus and lung	500	0.0
Malignant melanoma	.D	.
Other malignant neoplasm of skin	.D	.
Malignant neoplasm of breast	30	0.0
Malignant neoplasm of female genital organs	30	0.0
Malignant neoplasm of prostate	20	0.0
Malignant neoplasm of bladder	.D	.
Other malignant neoplasm, not listed above	250	0.0
Malignant neoplasm of lymphoid, hematopoietic and related tissue	100	0.0
Carcinoma in situ, all sites	.D	.
Benign neoplasm of colon	.D	.
Other benign neoplasm of digestive system	.D	.
Lipoma	60	0.0
Benign neoplasm of skin	.D	.
Benign neoplasm of uterus	150	0.0
Other benign neoplasm, not listed above	100	0.0
Neoplasms of uncertain behavior or unspecified nature	100	0.0
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism		
Anemias	900	0.1
Other diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	650	0.1
Complications of surgical and medical care	.D	.
Endocrine, nutritional and metabolic diseases		
Acquired hypothyroidism	90	0.0
Disorders of thyroid gland, excluding acquired hypothyroidism	150	0.0
Type 1 diabetes mellitus	1100	0.1

Primary diagnosis group	Number of visits	Percent distribution
Type 2 diabetes mellitus or unspecified	3600	0.5
Other types of diabetes mellitus	150	0.0
Other disorders of endocrine glands	300	0.0
Obesity	30	0.0
Hyperlipidemias	.D	.
Volume depletion	4300	0.6
Other nutritional deficiencies and metabolic disorders	1800	0.2
Complications of surgical and medical care	.D	.
Mental, behavioral and neurodevelopmental disorders		
Dementia, excluding Alzheimer's	300	0.0
Alcohol-related disorders, excluding alcohol-related dementia and chronic alcoholic liver disease	6300	0.9
Opioid-related disorders	2000	0.3
Cocaine-related disorders	100	0.0
Nicotine dependence	200	0.0
Other drug-related disorders excluding other drug-related dementia	3700	0.5
Schizophrenia	850	0.1
Non-mood psychoses, excluding schizophrenia	2000	0.3
Bipolar disorders, excluding those with depression	950	0.1
Bipolar disorders, with depression	100	0.0
Depressive disorders, excluding bipolar depression and adjustment reaction with depressed mood	7500	1.0
Dysthymic disorder	20	0.0
Acute reaction to stress and adjustment reaction, excluding those with depressed mood	650	0.1
Acute reaction to stress and adjustment reaction with depressed mood	200	0.0
Eating disorders	40	0.0
Impulse disorders	.D	.
Other mood disorders, nonpsychotic mental disorders, behavioral syndromes, and disorders of adult personality and behavior	8300	1.1
Attention-deficit/hyperactivity disorders	30	0.0
Oppositional defiant disorder	70	0.0
Conduct disorders, excluding oppositional defiant disorder	450	0.1
Autism spectrum disorder	70	0.0
Other mental disorders	900	0.1
Diseases of the nervous system		
Alzheimer's disease	70	0.0
Other degenerative diseases of the nervous system, excluding Alzheimer's disease	20	0.0
Migraine	8600	1.2
Transient cerebral ischemic attacks and related symptoms	1100	0.1
Sleep disorders, excluding sleep apnea (adult, pediatric, obstructive) and non-organic sleep disorders	400	0.1

Primary diagnosis group	Number of visits	Percent distribution
Obstructive sleep apnea (adult, pediatric), and sleep apnea, not otherwise specified	50	0.0
Sleep apnea (adult, pediatric, obstructive)	.D	.
Carpal tunnel syndrome	200	0.0
Other disorders of the nervous system	12500	1.7
Complications of surgical and medical care	250	0.0
Diseases of the eye and adnexa		
Inflammation and disorders of eyelid	500	0.1
Conjunctivitis	2100	0.3
Cataracts, excluding diabetic cataracts	.D	.
Retinal detachment and other retinal disorders, excluding diabetic retinopathy	90	0.0
Glaucoma	50	0.0
Other disorders of the eye and adnexa	2800	0.4
Complications of surgical and medical care	.D	.
Diseases of the ear and mastoid process		
Complications of surgical and medical care	.D	.
Disorders of external ear	1500	0.2
Otitis media and eustachian tube disorders	7000	1.0
Disorders of the ear and mastoid process	2300	0.3
Diseases of the circulatory system		
Heart valve disorders	40	0.0
Essential hypertension	3200	0.4
Hypertensive heart disease with heart failure	300	0.0
Hypertensive heart disease without heart failure	.D	.
Hypertensive chronic kidney disease with stage 1 through stage 4 chronic kidney disease or unspecified chronic kidney disease	200	0.0
Hypertensive chronic kidney disease with stage 5 chronic disease or end-stage renal disease (ESRD)	900	0.1
Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease or unspecified chronic kidney disease	90	0.0
Hypertensive heart and chronic kidney disease without heart failure with stage 1 through 4 chronic kidney disease or unspecified chronic kidney disease	.D	.
Hypertensive heart and chronic kidney disease with heart failure with stage 5 chronic kidney disease or ESRD	60	0.0
Hypertensive heart and chronic kidney disease without heart failure with stage 5 chronic kidney disease or ESRD	20	0.0
Secondary hypertension	40	0.0
Angina pectoris not stated as with chronic ischemic heart disease	300	0.0
Acute myocardial infarction (AMI)	850	0.1
Other acute and subacute ischemic heart disease	150	0.0

Primary diagnosis group	Number of visits	Percent distribution
Coronary atherosclerosis and other chronic ischemic heart disease (with angina pectoris)	250	0.0
Pulmonary heart disease and diseases of pulmonary circulation	750	0.1
Conduction disorders	150	0.0
Cardiac dysrhythmias, excluding ventricular fibrillation	4500	0.6
Cardiac arrest and ventricular fibrillation	750	0.1
Heart failure, non-hypertensive	850	0.1
Pericarditis, endocarditis, myocarditis and cardiomyopathy	300	0.0
Other and ill-defined heart disease	30	0.0
Cerebrovascular disease	1200	0.2
Diseases of the arteries, arterioles and capillaries	450	0.1
Varicose veins of lower extremity	250	0.0
Other disorder of circulatory system	4000	0.5
Complications of surgical and medical care	80	0.0
Diseases of the respiratory system		
Streptococcal pharyngitis and tonsillitis	3300	0.4
Acute sinusitis	1300	0.2
Acute pharyngitis, except streptococcal pharyngitis	5200	0.7
Acute tonsillitis, except streptococcal tonsillitis	850	0.1
Influenza	3800	0.5
Pneumonia	5900	0.8
Acute bronchitis and bronchiolitis	8400	1.1
Other acute respiratory infections	17500	2.4
Allergic rhinitis	200	0.0
Chronic sinusitis	1300	0.2
Deviated nasal septum	.D	.
Chronic diseases of tonsils and adenoids	30	0.0
Chronic and unspecified bronchitis	3900	0.5
Emphysema and other chronic obstructive pulmonary disease, including chronic obstructive asthma	2500	0.3
Asthma, excluding chronic obstructive asthma	6000	0.8
Respiratory failure	450	0.1
Other diseases of the respiratory system	2300	0.3
Complications of surgical and medical care	400	0.1
Diseases of the digestive system		
Diseases of the teeth and supporting structures, excluding dentofacial anomalies and disorders of the jaw	5300	0.7
Esophagitis without gastroesophageal reflux disease	300	0.0
Gastroesophageal reflux disease (with esophagitis)	1400	0.2
Other diseases of the esophagus	500	0.1
Ulcers of stomach and small intestine	650	0.1
Gastritis and duodenitis	2600	0.4
Appendicitis	1200	0.2
Diaphragmatic hernia	150	0.0

Primary diagnosis group	Number of visits	Percent distribution
Hernias of abdominal cavity, except diaphragmatic hernia	1600	0.2
Crohn's disease and ulcerative colitis	850	0.1
Other and unspecified noninfectious enteritis and colitis	6400	0.9
Intestinal obstructions	900	0.1
Diverticula of intestine	2400	0.3
Irritable bowel syndrome	100	0.0
Constipation	5100	0.7
Anal and rectal diseases	2000	0.3
Hemorrhoids and perianal venous thrombosis	850	0.1
Alcoholic liver disease	200	0.0
Other diseases of the liver	450	0.1
Disorders of gallbladder and biliary tract	3800	0.5
Diseases of the pancreas	250	0.0
Unspecified gastrointestinal bleeding	2100	0.3
Other diseases of the digestive system	2100	0.3
Complications of surgical and medical care	700	0.1
Diseases of the skin and subcutaneous tissue		
Cellulitis	11000	1.5
Cutaneous abscess	5700	0.8
Other local infections of the skin and subcutaneous tissue	1300	0.2
Contact dermatitis and other eczema	700	0.1
Psoriasis and other similar disorders	90	0.0
Urticaria	2200	0.3
Other inflammatory conditions of skin and subcutaneous tissue	2000	0.3
Actinic keratosis and other sun exposure related disorders	200	0.0
Acne	30	0.0
Sebaceous cyst	100	0.0
Seborrheic keratosis	.D	.
Corns, callosities and other hypertrophic and atrophic skin condition	60	0.0
Pressure ulcers	90	0.0
Other disorders of the skin and subcutaneous tissue	1500	0.2
Complications of surgical and medical care	80	0.0
Diseases of the musculoskeletal system and connective tissue		
Rheumatoid arthritis	150	0.0
Juvenile arthritis	.D	.
Infectious and inflammatory arthropathies, excluding rheumatoid and juvenile arthritis	1300	0.2
Osteoarthritis	850	0.1
Acquired deformities of fingers and toes	50	0.0
Internal derangement of knee	400	0.1
Other joint disorders	9600	1.3
Spinal stenosis	150	0.0
Spondylopathies, excluding spinal stenosis	250	0.0
Intervertebral disc disorders	1200	0.2

Primary diagnosis group	Number of visits	Percent distribution
Low back pain, unspecified	7500	1.0
Other conditions of the spine and back, excluding low back pain	11000	1.5
Synovitis and tenosynovitis	200	0.0
Soft tissue disorders related to use, overuse and pressure	2000	0.3
Ganglion and cyst of synovium, tendon and bursa	300	0.0
Myalgia and myositis, unspecified	850	0.1
Osteoporosis	.D	.
Disorders of bone and cartilage, excluding osteoporosis	1300	0.2
Other diseases of the musculoskeletal system and connective tissue	8800	1.2
Complications of surgical and medical care	80	0.0
Diseases of the genitourinary system		
Nephritis, nephrotic syndrome, and nephrosis	40	0.0
Infections of kidney	5000	0.7
Acute kidney failure	350	0.0
Chronic kidney disease, excluding ESRD	70	0.0
ESRD	100	0.0
Unspecified kidney failure, including uremia not otherwise specified	40	0.0
Calculus of kidney and ureter	7500	1.0
Cystitis	2000	0.3
Urethral stricture	30	0.0
Urinary tract infection, site not specified	12000	1.6
Stress and other specified urinary incontinence, excluding functional	.D	.
Other diseases of the urinary system	7000	1.0
Benign prostatic hyperplasia	250	0.0
Disorders of prepuce	150	0.0
Other disorders of the male genital system	2100	0.3
Unspecified lump or mass in breast	80	0.0
Disorders of the breast, excluding unspecified lump or mass	200	0.0
Inflammatory disease of female pelvic organs	1300	0.2
Endometriosis	150	0.0
Genital prolapse (female)	70	0.0
Other noninflammatory disorders of the female genital organs	300	0.0
Disorders of menstruation and abnormal bleeding	2900	0.4
Menopausal and postmenopausal disorders	50	0.0
Other disorders of female genital tract	600	0.1
Complications of surgical and medical care	200	0.0
Complications of pregnancy, childbirth, and the puerperium		
Missed abortion	200	0.0
Supervision of high-risk pregnancy	30	0.0
Pre-existing diabetes mellitus, types 1 and 2, complicating pregnancy	30	0.0
Pre-existing diabetes mellitus, types 1 and 2, complicating pregnancy, childbirth and the puerperium	.D	.
Early or threatened labor	450	0.1
Other complications of pregnancy	18000	2.4

Primary diagnosis group	Number of visits	Percent distribution
Other complications of childbirth	.D	.
Other complications of the puerperium	.D	.
Other pregnancy with abortive outcome	1700	0.2
Certain conditions originating in the perinatal period		
Sleep apnea of newborn	20	0.0
Certain other conditions originating in the perinatal period	850	0.1
Congenital malformations, deformations and chromosomal abnormalities		
Congenital anomalies	200	0.0
Symptoms, signs and ill-defined conditions		
Abnormal heart beat and heart sounds	3800	0.5
Epistaxis	3700	0.5
Cough, unspecified	2500	0.3
Dyspnea and respiratory abnormalities	5100	0.7
Chest pain	30500	4.1
Abdominal pain	45500	6.2
Fecal incontinence	.D	.
Unspecified jaundice, edema and other non-specific skin symptoms	6700	0.9
Hematuria	1200	0.2
Urinary incontinence, unspecified and functional	50	0.0
Symptoms involving the urinary system, excluding hematuria and urinary incontinence	2900	0.4
Age-related cognitive decline, age-related physical debility	.D	.
Vertigo and lightheadedness	5000	0.7
Fever of other and unknown origin	6000	0.8
Headache	12000	1.6
Malaise and fatigue	3700	0.5
Syncope and collapse	6500	0.9
Convulsions and seizures, not elsewhere classified	3400	0.5
Other symptoms, signs, abnormal findings and ill-defined conditions	34000	4.6
Complications of surgical and medical care	.D	.
Injury and poisoning		
Other injuries, excluding burns and poisonings	600	0.1
Burns and corrosions, external and internal, excluding sunburn	.D	.
Complications of surgical and medical care	50	0.0
External-cause codes		
Injuries due to other external causes	.D	.
Supplementary classifications		
Human immunodeficiency virus syndrome (HIV, HIV+, HIV positive)	.D	.
Type 2 diabetes mellitus or unspecified	.D	.
Diagnosis with no matching code classification	189000	25.7
Encounter for general adult medical examinations, including routine gynecological examination	950	0.1
Encounter for routine newborn health examination	70	0.0

Primary diagnosis group	Number of visits	Percent distribution
Encounter for routine child examination, excluding newborns	200	0.0
Encounter and observations for suspected conditions ruled out	2000	0.3
Encounter for specific procedures and aftercare and follow-up examination after completed treatment, excluding for injuries	2900	0.4
Potential health hazards related to communicable diseases	500	0.1
Encounter for contraceptive management	50	0.0
Fertility and genetic counseling and screening	.D	.
Encounter for supervision of normal pregnancy	250	0.0
Other encounter related to pregnancy, excluding incidental pregnancy	150	0.0
Postpartum care and examination	.D	.
Personal history of pulmonary embolism and other venous thrombosis and embolism	.D	.
Personal history of cerebral infarction or TIA without residual deficits	.D	.
Potential health hazards related to personal and family history, excluding personal history of pulmonary embolism and personal history of cerebral infarction or TIA without residual deficits	200	0.0
Body mass index 30 or greater, adult	.D	.
Other factors influencing health status and contact with health services	3000	0.4
Unknown or blank	900	0.1

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Notes: .D are cells suppressed due to small cell size. Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-13. Presence of chronic conditions at emergency department visits: Utah, 2017

Chronic condition	Number of visits	Percent distribution
All visits	**736000**	**100.0**
Alzheimer's disease or dementia	400	0.1
Asthma	8500	1.2
Cerebrovascular disease or transient cerebral ischemic attack	2300	0.3
Chronic kidney disease	70	0.0
Acquired hypothyroidism	90	0.0
Disorders of thyroid gland, excluding acquired hypothyroidism	150	0.0
Diabetes mellitus - Type 1	1100	0.1
Diabetes mellitus - Type 2 or unspecified	3600	0.5
Hypertension	3200	0.4
Obesity	30	0.0
Obstructive sleep apnea	50	0.0
Other	20	0.0
Blank	900	0.1
None of the above	716000	97.3

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Note: Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-14. Injury visits to emergency departments, by selected patient characteristics: Utah, 2017

Patient and hospital characteristic	Number of visits	Percent distribution	Number of visits per 100 persons per year
All injury visits	**178000**	**100**	**5.7**
Age group (years)			
Under 15	43000	24.2	5.6
1-4	16500	9.3	6.5
5-14	26500	14.9	5.1
15-24	31500	17.7	6.3
25-44	48000	27.0	5.5
45-64	30500	17.1	5.0
65 and over	24500	13.8	7.3
65-74	11500	6.5	5.7
75 and over	13000	7.3	9.8
Female	**84000**	**47.2**	**5.5**
Under 15	18000	10.1	4.8
15-24	14000	7.9	5.8
25-44	22000	12.4	5.1
45-64	15500	8.7	5.1
65-74	6200	3.5	5.8
75 and over	7800	4.4	10.6
Male	**94000**	**52.8**	**6.0**
Under 15	25000	14.0	6.3
15-24	17500	9.8	6.8
25-44	26000	14.6	5.9
45-64	15000	8.4	4.9
65-74	5100	2.9	5.3
75 and over	5200	2.9	8.7
Metropolitan status			
MSA	149000	83.7	5.4
Non-MSA	29000	16.3	8.9

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Notes: The 2017 ACS 1-year estimates for Utah (data.census.gov) were used as the denominator for the number of visits per 100 persons per year. Percent distribution is based on rounded counts and therefore may not add up to 100. Sub-categories may not sum to total due to rounding.

Table 2-15. Injury visits to emergency departments, by race, age, and ethnicity: Utah, 2017

Patient characteristic	Number of visits	Percent distribution	Number of visits per 100 persons per year
All injury visits	**178000**	**100**	**5.7**
Race and age group (years)			
White	**149000**	**83.7**	**5.6**
Under 15	35000	19.7	5.5
15-24	25500	14.3	6.1
25-44	39500	22.2	5.3
45-64	26000	14.6	4.8
65-74	10500	5.9	5.5
75 and over	12000	6.7	9.5
Black or African American	**3400**	**1.9**	**9.0**
Under 15	900	0.5	8.4
15-24	800	0.4	10.2
25-44	1100	0.6	11.2
45-64	550	0.3	7.4
65-74	60	0.0	5.1
75 and over	30	0.0	5.5
Other	**26000**	**14.6**	**8.3**
Under 15	6900	3.9	8.3
15-24	5300	3.0	9.6
25-44	7800	4.4	7.4
45-64	4000	2.2	7.2
65-74	1000	0.6	9.5
75 and over	900	0.5	16.6
Ethnicity			
Hispanic or Latino	15000	8.4	3.5
Not Hispanic or Latino	113000	63.5	4.2
White	104000	58.4	4.2
Black or African American	2000	1.1	5.6
Other	7100	4.0	3.5
Unknown or blank	49500	27.8	.

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Notes: The 2017 ACS 1-year estimates for Utah (data.census.gov) were used as the denominator for the number of visits per 100 persons per year. Percent distribution is based on rounded counts and therefore may not add up to 100. Sub-categories may not sum to total due to rounding.

Table 2-16. Emergency department visits related to injury, poisoning, and adverse effect, by intent: Utah, 2017

Intent	Number of visits	Percent distribution
All injury visits related to injury, poisoning, and adverse effect	**178000**	**100**
Unintentional	135000	75.8
Self-harm	1100	0.6
Assault	4200	2.4
Legal intervention/war	150	0.1
Undetermined or other	10500	5.9
Blank cause	26500	14.9

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.
Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.
Note: Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-17. Emergency department visits related to injury, poisoning, and adverse effect, by mechanism: Utah, 2017

Mechanism	Number of visits	Percent distribution
All injury visits related to injury, poisoning, and adverse effect	**178000**	**100**
Cut or pierce	13000	7.3
Drowning or submersion	100	0.1
Fall	47500	26.7
Fire or flame	450	0.3
Hot object or substance	1200	0.7
Firearm	250	0.1
Machinery	1100	0.6
All transportation	21500	12.1
Motor vehicle-traffic	15000	8.4
Motor vehicle-nontraffic	1300	0.7
Pedal cyclist, other	2500	1.4
Pedestrian, other	250	0.1
Other land transport	2100	1.2
Other transport	200	0.1
Natural or environmental	1000	0.6
Overexertion	8600	4.8
Struck by or against	22000	12.4
Other specified	4200	2.4
Unspecified or other	20000	11.1
Blank cause	37000	20.8

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Note: Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-23. Providers seen at emergency department visits: Utah, 2017

Type of provider	Number of visits	Percent distribution
All visits	**749000**	**100**
Any physician[†]	284000	37.9
Emergency department attending physician	243000	32.4
Nurse practitioner	9000	1.2
Any physician seen	400	0.1
No physician seen	8600	1.1
Physician assistant	7500	1.0
Any physician seen	400	0.1
No physician seen	7100	0.9
Emergency medical technician	3500	0.5
Registered nurse or licensed practical nurse, mental health provider, or other	11500	1.5
Blank	434000	57.9

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.

Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.

Notes: [†]Any physician includes emergency department attending physicians and all other physicians. Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-24. Disposition of emergency department visits: Utah, 2017

Disposition	Number of visits	Percent distribution
All visits	**736000**	**100**
Routine	700000	95.1
Admitted, transferred, or died		
Admit to this hospital	900	0.1
Return or transfer to nursing facility	1500	0.2
Transfer to psychiatric hospital	8200	1.1
Transfer to other hospital	11500	1.6
Died in the hospital	850	0.1
Left prior to completing visit		
Against medical advice	3800	0.5
Other	9400	1.3

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.
Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.
Note: Percent distribution is based on rounded counts and therefore may not add up to 100.

Table 2-25. Emergency department visits resulting in hospital admission, by selected patient and visit characteristics: Utah, 2017

Selected characteristic	Number of visits	Percent distribution	Number of visits per 100 persons per year
All admission visits	**20500**	**100**	**0.7**
Age (years)			
Under 15	2000	9.8	0.3
15-24	3600	17.6	0.7
25-44	5500	26.8	0.6
45-64	4800	23.4	0.8
65-74	2200	10.7	1.1
75 and over	2400	11.7	1.8
Expected source of payment			
Private insurance	6200	30.2	0.2
Medicare	5700	27.8	0.2
Medicaid or CHIP	3500	17.1	0.1
No insurance	2000	9.8	0.1

Source: Utah Department of Health (UDOH) (2017). Utah Healthcare Facility Limited Use Data Sets, Emergency Department Encounter Data, 2017.
Universe: All Utah residents who visited a Utah Emergency Department (ED) in 2017.
Notes: The 2017 ACS 1-year estimates for Utah (data.census.gov) were used as the denominator for the number of visits per 100 persons per year. Percent distribution is based on rounded counts and therefore may not add up to 100.

Appendix C: Data Confidentiality and Disclosure Avoidance

UDOH and the Census Bureau have worked together to define a system for safeguarding confidential data. These measures are broadly defined by three components, namely, data confidentiality, system security, and disclosure avoidance (DA). The data confidentiality and system security processes and procedures are outlined in the Joint Statistical Project's (JSP) Memorandum of Agreement (MOA). The DA processes and procedures are defined by the Census Bureau as well as by the UDOH Data Suppression and Data Aggregation Guidelines.

The MOA signed by UDOH and the Census Bureau specified the authorities of each party to enter into this joint project. The Census Bureau's authority to conduct statistical activities is governed by Title 13 of the U.S. Code. The authority for UDOH to enter into this agreement is Utah Health Codes Title 26 Chapter 1, 3, and 8a-part 2-203. The agreement requires that the confidential data can only be used for statistical purposes as described in the research plan specified in the MOA. The research plan was reviewed and approved by the UDOH Institutional Review Board (IRB) and executives. The request was also reviewed and approved by the Utah Health Data Committee at an open and public meeting and State of Utah executives. Only the minimum required data was shared in order to complete the aims of the agreement. The confidential data cannot be disclosed or published in any way that permits identification of a particular individual or an entity. Maintaining confidentiality of these data is guaranteed under Title 13 of the U.S. Code Section 9 and the Privacy Act of 1974.

The purpose of the data confidentiality measures is to maintain confidentiality at all steps of the data management process. These processes and procedures serve to limit who has access to the data, ensure appropriate content of processed datasets, restrict processed data from public release, and approve how released products will appear. The Census Bureau has significant safeguards in place to ensure that only authorized staff from the Census Bureau can analyze these datasets and only within the Census Bureau's authorized IT environment. Personnel having access to the system have been trained in Title 13 and information security requirements and understand that there are severe penalties for any misuse. A minimum number of analysts required to complete the project were authorized to access the confidential data. The record linkage identifiers used at the Census Bureau do not contain any health information or direct identifiers. Instead, Protected Identification Keys (PIKs) are used to anonymize records and link to existing Census Bureau data. All processed datasets for this project do not contain any UDOH personally identifiable information such as name, address, social security number, or date of birth, as these fields are used only in the initial PIK generation phase with authorized access for only a few employees at the Census Bureau.

The purpose of the system security measures is to protect all data stored in Census Bureau IT systems at all times. All Census Bureau systems are fully assessed against NIST Special Publication 800-53r4, as well as Special Publication 800-37r1. Data acquired under this project have been treated as if they have, at a minimum, protection at the appropriate risk level in

accordance with the National Institute of Standards and Technology (NIST) Federal Information Processing Standards (FIPS) 200 and Special Publication 800-60r1. The Census Bureau IT Security Program is reviewed annually by the Department of Commerce Office of the CIO as well as the Department of Commerce Office of Inspector General as part of the oversight responsibilities.

More information about Census Bureau data security[23], privacy and confidentiality[24] measures in general are available online (Census Bureau, 2020e; Census Bureau, 2021). More information about the specific measures taken for this project can be found in the MOA.

All publicly released products, including this work, must undergo formal review by the Census Bureau's Disclosure Review Board (DRB) before release. The purpose of this multi-step process is to fully protect sensitive and/or confidential data from disclosure. The published data must meet established standards that ensure the released data contain no personally identifiable information and, moreover, contain no information that can be made personally identifiable when combined with other publicly-available resources. In addition, the published data must not be more detailed than is necessary for the project aim(s). DRB staff conduct a thorough risk evaluation for each product before approving it for publication. For this project, examples of these criteria include:

> a) a minimum weighted size of 10,000 people; b) a minimum cell size of 3 unweighted people (though we used a minimum cell size of 15 unweighted people); c) a universe size of 50 unweighted people; d) rounding unweighted observations (or numbers related to observations); and e) rounding output and estimates for public release to four significant digits.

Projects with data that do not meet these standards may either withdraw or alter and then resubmit their data for review, using disclosure avoidance procedures to modify or remove the characteristics that put confidential information at risk for disclosure. These procedures may include extending the number of data years to increase dataset, cell, and universe size; using complementary cell suppression; collapsing categories and/or groups; and using special rounding programs to round applicable numbers based on their size and origin. For this work, some of the more detailed cells were proactively collapsed into broader categories to ensure that all disclosure-avoidance requirements were clearly met. More information about the Census Bureau's DRB and disclosure-avoidance procedures can be found online[25] (Census Bureau, 2020f).

Additionally, we verified that all of UDOH's Data Suppression and Data Aggregation Guidelines have been met. The UDOH's guidelines specify that data must have: 1) a minimum reported cell size of 11 (though we used a minimum cell size of 15 unweighted people in this project); 2) base

[23] https://www2.census.gov/foia/ds_policies/ds007.pdf
[24] https://www.census.gov/history/www/reference/privacy_confidentiality/
[25] https://www2.census.gov/foia/ds_policies/ds025.pdf

population of 100; 3) relative standard error (RSE) <=50%; and 4) the risk ratio of disclosure and potential need for data suppression be considered for each dataset. More information about UDOH's Guidelines[26] and Census Bureau's DRB[27] practices are available online (UDOH, n.d.; Census Bureau, 2020f).

[26] https://ibis.health.utah.gov/ibisph-view/pdf/resource/DataSuppressionSummary.pdf
[27] https://www2.census.gov/foia/ds_policies/ds025.pdf